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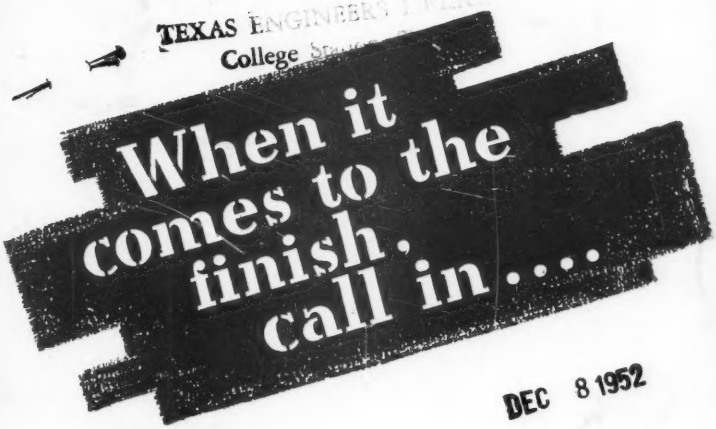

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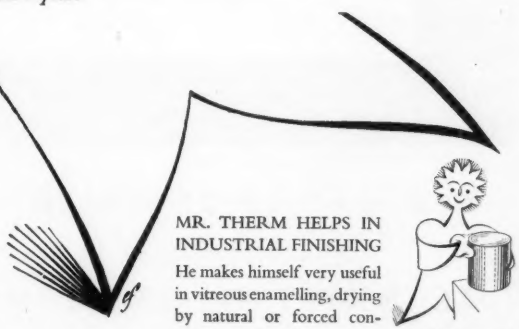

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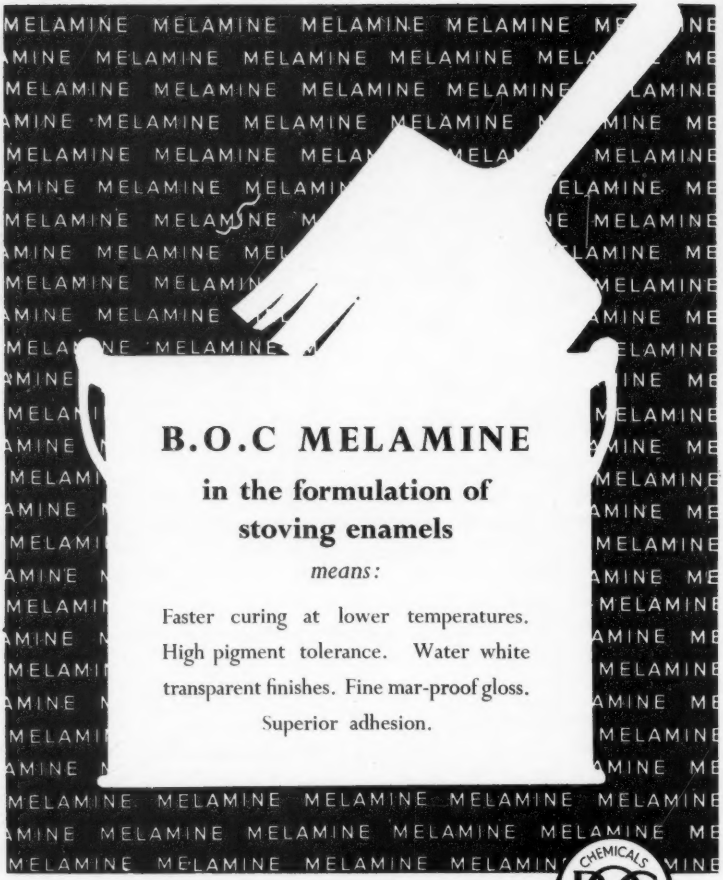

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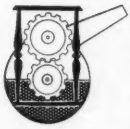

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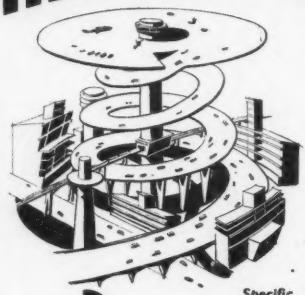

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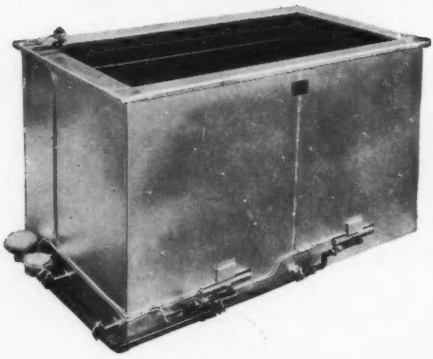

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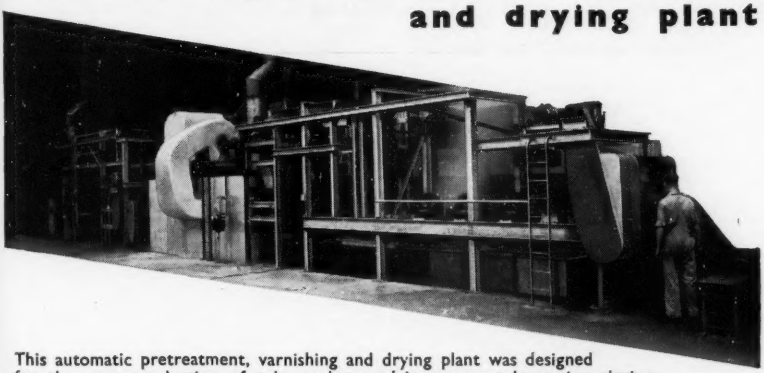

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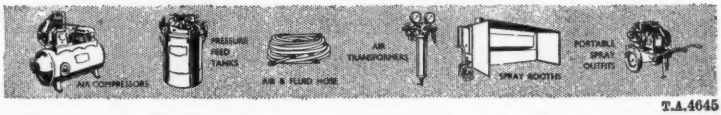

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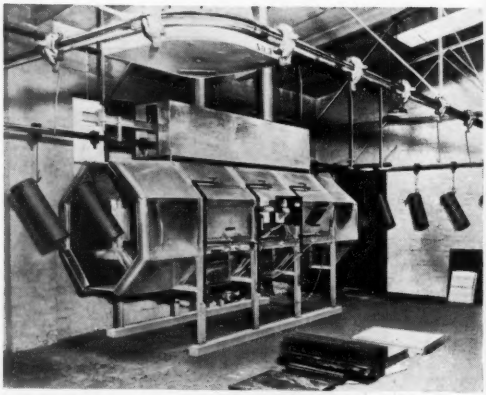

A tunnel of Bratt Colbran Radiant Units stoving finishes on food canisters.
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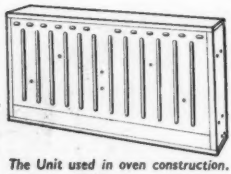

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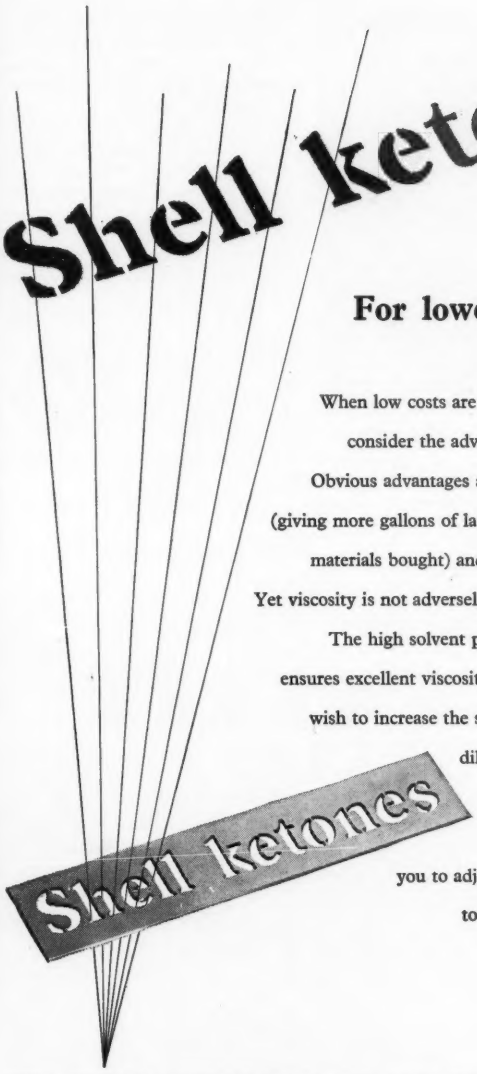

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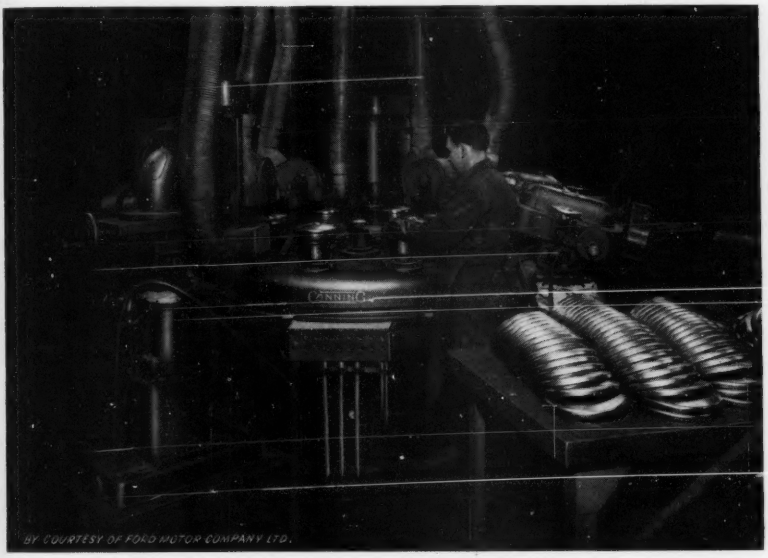

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NOVEMBER 1952

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WILFRED F. COXON, M.Sc., Ph.D., F.R.I.C., F.I.M., M.Inst.F.

Managing Director of the Publishers, Arrow Press Limited.

Born on Tyneside, 1911. Educated at Rutherford College, Newcastle-on-Tyne, and the Universities of Durham, Nottingham and London.

Graduate of London University. Bachelor of Science, First Class Honours, Chemistry, 1932.

Master of Science (London) by research on Silicones, under the late Professor F. S. Kipping, F.R.S.

Doctor of Philosophy (London) by research under Professor G. R. Clemo, F.R.S., King's College, University of Durham.

Works Chemist, Turner & Newalls Ltd. Research Chemist, Imperial Chemical Industries Ltd. Senior Science Master, King Edward's Grammar School, Birmingham. Lecturer in Applied Chemistry, The Polytechnic, Regent Street, London.

At the outbreak of war, joined the Air Ministry and subsequently the Ministry of Aircraft Production. Eventually promoted Principal Technical Officer.

Here responsible for research and development on pyrotechnics and incendiaries, and ultimately the research and development of the special armament equipment used by the Pathfinder Force of Bomber Command and the American Army Air Force.

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On leaving the Ministry in 1946, built up a useful consulting practice covering the gas industry, and also appointed Technical Advisor to the Royal Swedish Air Board.

Edited and broadcast a magazine series with the British Broadcasting Corporation entitled "Industrial Britain."

Freelance contributor to Technical and National Press.

Founder Editor of "Industrial Finishing." Appointed Director of Arrow Press in 1951.

Industrial Finishing

VOL. 5 NOVEMBER, 1952 NO. 53

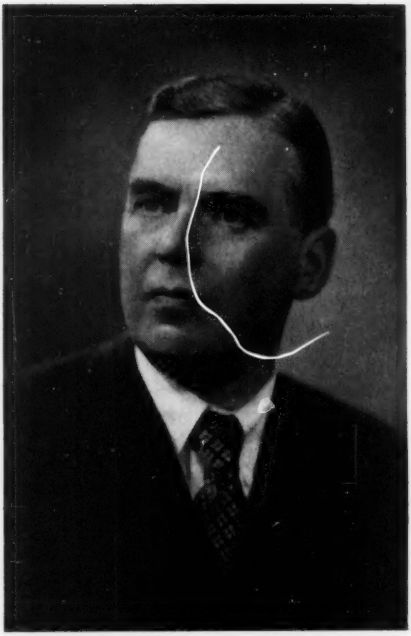
THE POLICY OF "INDUSTRIAL FINISHING"

THIS publication was introduced because it was thought that in Britain there was little coverage given to the technology of the finishing industry in its broadest sense. Its introduction was primarily to attract and provide interest value for the works executive grades—it was not introduced as an attempt to publish highly academic papers for the scientist and research worker, because the various professional associations and institutions cover this field extremely well. It was, rather, to be a résumé of practical achievements in the field of finishing technology.

Progress has been made and now the publishers have no doubt whatsoever that the journal is fulfilling a useful purpose.

INDUSTRIAL FINISHING dovetails into the general policy of Arrow Press Ltd., which can be summarised as follows. There is a tendency today towards power resting in the hands of the economist and politician, who have copious suggestions as to how the national wealth should be dispensed. On the other hand, it is productive industry which has to earn that wealth, and in this respect, one refers to productive industry in the sense of management and men, irrespective of whether the industry is nationalised or not. Although both management and men are producing the nation's wealth, yet because of our peculiar political drift they are having less and less say in the distribution of that wealth. In fact, because the economist and political leader does not have the day-to-day responsibility of earning the nation's wealth he is becoming most reckless in the methods he suggests towards its distribution. In fact this recklessness is reflected in various measures which are day-by-day rendering the task of production considerably more difficult. And when productivity faces such hazards it is as well to remember that the direct consequence is a reduction in the standard of living of the community, which by short-sighted action, the bland economist and politician offers to save by short-term measures of popular expediency, summarised in the phrase "Live for today. . . ." Most assuredly, unless industry does get a chance to express its case commercially and economically, the end of the phrase "For tomorrow we die" is likely to be realised.

Thus the policy of Arrow Press publications in the technical field is to be directed towards a resurgence of the strong case of industrial management and men. Editorially our lead will always be towards ensuring that their case is pre-eminently presented on all aspects of interest to them. No claim is made to be impartial in this respect. The policy is one of distinct partiality to those working in and responsible for industrial productivity. That is, indeed, fundamental in the policy which will be pursued relentlessly.



Mr. Mervyn R. Harley, J.P., a new director of Arrow Press Ltd., who is taking over the commercial management. Well known in London, he was responsible for founding and editing the "Wembley News" from 1923 until recently. He has been managing director of the "Wembley News" since 1933. Was trained as an economist in the London School of Economics. Elected to the Wembley Council in 1922 and became its chairman in 1933. Elected Alderman on the creation of the Borough of Wembley in 1936. Served on the Middlesex County Council during the war and is a past president of the Wembley Chamber of Commerce and the Wembley Rotary Club. Was appointed to serve on the Bench in 1942

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THE INSTITUTE AND ORGANIC FINISHING

by ARGUS

IN writing what is to be written I will probably be a wee bit unpopular, but that cannot be helped!

One cannot help listening to the rank and file element of any organisation—the people who pay their subscriptions and keep things going. And in the Institute of Metal Finishing all is not well. Nearly twelve months ago the question of an organic finishing section of the Institute was raised and a meeting called in London of a few paint "bods" after which the Council of the Institute duly issued an edict with all solemnity to the effect that in the autumn there would be a day conference to launch this newly-envisaged organic section.

In the Spring

It was suggested to the Institute that the Eastbourne Conference was an occasion whereby at least something attractive to the potential organic section might be introduced—but for one reason or another the Conference was largely devoted to finishing techniques other than organic. However, all was promised for the autumn, and the autumn leaves have fallen and now it is to be in the Spring! Judging from information made available by the publicity department of the Institute, little has been done about this organic section. This, indeed, puts the trade and technical press into a bit of a quandary. Its help and assistance is sought in all good faith, readers are told authoritatively by the Institute that such a conference will be called —all kinds of original ideas are put forward—the Industrial Finishing Luncheon Club was used as a platform to talk about the idea and then, everyone having got into at least a receptive mood, the idea is shelved and one finds the original E.T.S. officers working on the original E.T.S. programme and yes, being accused of masquerading in the new name of an Institute of Metal Finishing.

Undoubtedly, however, the sponsors have allowed the imposing new title to lead them into paths of ever-increasing dignity. Most associations and institutes, and so on, have an annual dinner or an inaugural dinner —but the Institute of Metal Finishing has an inaugural "banquet"—no doubt a chicken by any other name. . . .

For highly materialist production associations this dinner is frequently attended in a lounge suit—or if a spice of dignity is necessary, maybe evening dress—but for the inaugural banquet of the Institute of Metal Finishing it was evening dress with decorations. I know Mrs. Hothersall was the guest of honour but I also know that evening dress did keep the attendance down considerably—and I also know that our dear friend Hothersall was an unassuming yet industrious researcher. A larger attendance in lounge suits would have pleased him more. It is rumoured that one of the resolutions before Council is that in future the president and officials of Council and local sections must attend meetings in morning dress—but maybe this is just a rumour!

British Council of Productivity

Then again at Eastbourne in April, 1952, the Institute had at its conference dinner Lt.-Gen. Sir Thomas Hutton, K.C.I.E., C.B., M.C., general manager of the American Council of Productivity to propose the toast of the Institute. He took the occasion to boost the activities of the Anglo-American Council and talked in sanguine terms of its decease. And lo and behold at the inaugural banquet six months later the same Lt.-Gen. Sir Thomas Hutton proposes precisely the same toast, says precisely the same

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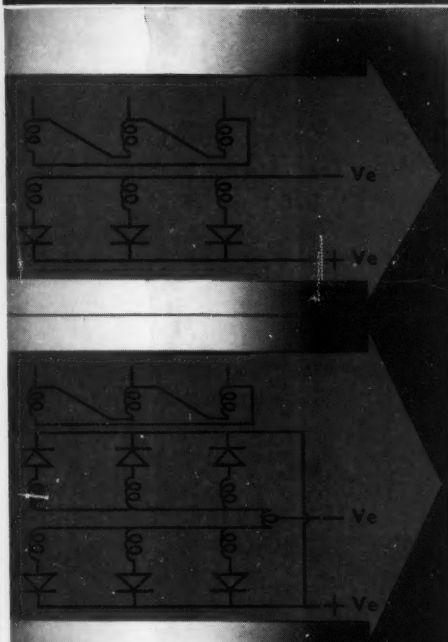

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kind of things about his organisation, the Anglo-American Council of Productivity, and goes one stage further to say that although the old Anglo-American Council had reached the point of no return and the expensive swanning trips to America were over, nevertheless the Council was not going to die but to be reborn in another new organisation—a British Council of Productivity, which means, presumably, that the permanent officials of the old will still find jobs in the new!

Although the objects of the new are as yet undefined, it seems that its staff are going to stump the countryside telling the British manufacturer how supremely clottish is his technical efficiency and how much better it would be were he to read the Anglo-American Productivity Council's reports! Maybe it would be unfair to remind Sir Thomas that productivity and speed are somewhat synonymous terms, and that practically no Anglo-American Productivity Report ever appeared in print to British industry until the smooth working Americans had torn up the production lines to which the Report referred. The team members came back pledged on a blood curdling oath to keep its secrets from British industry until the Report was issued which meant twelve months delay on an enterprise which was built around speedy productivity—and just in case the Council would blame the team for laggardly reports, one gathers that this was certainly not the case with the finishing team.

Two boosts—it resembles the stars on TV—to another excrudescence on British industry by the same general manager under the auspices of the same Institute within six months is not likely to be of value to the finishing industry upon whom the future of the Institute depends.

Is it that the "organic" interests look at the present make-up of the Institute of Metal Finishing and see the chromium-plate from the original fittings and realise that paint adhesion on to chromium-plating is still a ticklish problem?

Poor Relations

As has been said before in this journal, the Institute of Metal Finishing, catering for the broad user requirements of the finishing industry in general can fulfil a useful purpose, but if it sets out to attract the organic side of the industry it must realise that a flea cannot swallow an elephant, although they can both live in close harmony! If the organic section is formed as a real and useful body, financially and technically it will to a large extent submerge the old E.T.S. This is, of course, the story of progress. He who pays the piper, rightly or wrongly, calls the tune. The E.T.S. had vision and foresight in conceiving the idea of an Institute of Metal Finishing, but if it ever imagined that the organic section could be looked upon as a poor relation and that the old Order in Council would prevail, they were making a tremendous mistake. If the object of the Institute and its wider ramifications was conceived in sincerity then the Council can do no better than co-opt into itself a number of nominees representing the organic side of the industry and ensure that all future policy is framed within the orbit of the organic interest.

Wise to Most Moves

But if the existing council imagines that it can gain the power offered by the organic finishing industry and use it without this increased power being reflected in authority at Council level, it is kicking against the pricks. The paint industry is an old one. It is wise to most moves—because of its age it views new ideas with some suspicion for it has been caught before. It is useless to argue that electroplating, galvanizing, vitreous enamelling, painting, metal spraying, so on, and so on are not competitive—many a job can be completed effectively by one or the other process and they all sell more or less in competition.

From all corners of industrial Britain one hears more and more emphatic prognostications upon competition and the need to increase sales so that the Institute of Metal Finishing to succeed must truly represent the user of finishing materials in the main. Of course, suppliers will undoubtedly become corporate members if they can be certain that their industry gets a reasonable break, but the activity and strength of the Institute must come from the users.

The trumpets have sounded, the organic section is conceived, it was to be born in the autumn but for cir-

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cumstances beyond someone's control it remains in suspended animation to the Spring. It would be a very sound thing for the Institute to issue an official statement saying precisely what they envisage by the organic section, what response they have had from the paint industry, and what they are going to do about it.

And it might also be borne in mind that if the inaugural banquet had taken place in Birmingham in lounge suits, instead of about 100 being represented, the number would have been nearly doubled—this is not a personal opinion, it is based upon numerous conversations and numerous expressions of opinion.

The point is, what is the Institute doing about its organic section? If nothing, say so! If something, say what it is!

There is a black-country expression which summarises this sentiment—but fortunately it has slipped my memory.

FILMS BY ASSOCIATED LEAD MANUFACTURERS

FILMS are established as educational and promotional media, and "White Lead" made by World Wide Pictures Ltd., for Associated Lead Manufacturers Ltd., is a useful combination. With a running time of 20 min. it tells the story of the production of this material by the earlier Chamber Process and the modern Octagon Process. The film then shows the production of "dry" white lead and white lead ground in oil. By means of photomicrography the reason for the interaction of the product with linseed oil is shown in detail. The film concludes with a convincing demonstration of the protective value of white lead as a base for paint.

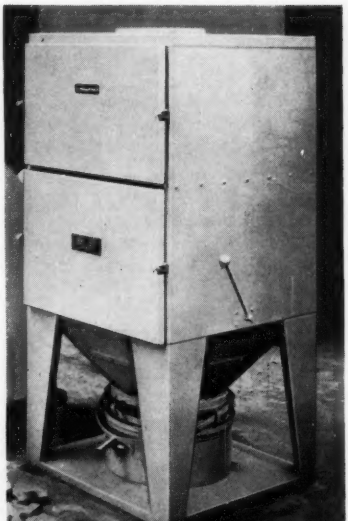
The second film, "Magnet—a white lead paint," is promotional in character, but has much interest value, showing as it does the effect of weather and the other factors acting on buildings, and the care and control exercised in the production of "Magnet" brand of white lead paint. This part of the film was made at Millwall, London, where Associated Lead have one of the most up-to-date plants in the country.

"White Lead" is available in 35 mm. and 16 mm. black and white and is of considerable value for technical schools and educational interest generally, whilst "Magnet," which is in 16 mm. Kodachrome, running time 16 min., is mainly designed for showing to paint specifiers and users.

Cecil D. Notley Advertising Ltd., have collaborated with World Wide Pictures in the production of the films.

Those interested should apply to Associated Lead Manufacturers Ltd., Ibex House, Minories, London, E.C.3.

The Birmingham Paint, Varnish and Lacquer Club.—On the 4th December, Mr. C. E. Hollis, B.Sc. (Lond.), of The Distillers Co. Ltd., will present a paper entitled, "Styrene-Butadiene Emulsions."



Dallow, Lambert and Co. Ltd., of Leicester, announce a new type of unit dust collector, which is at present available in the 100 Series, and will shortly be offered in two other series, 50 and 150, making a total of 135 different combinations from which requirements may be selected. Fixed fan, filter and storage capacities have, in the past, limited application of large units. The new unit under the trade name "Dustmaster" is claimed to overcome this limitation

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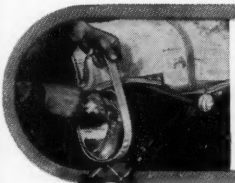

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First Hothersall Memorial Lecture—An Extract

THE first Hothersall Memorial Lecture given under the auspices of the Institute of Metal Finishing was presented by Dr. G. E. Gardam on Wednesday, 22nd October, 1952, in the Grand Hotel, Birmingham. In his introduction the speaker said they were there to pay homage to the memory of Arthur Wesley Hothersall, and commented upon his major contributions to the scientific and electrical side of electrodeposition. The lecturer had known Mr. Hothersall, who was a Yorkshireman, since 1925, and he went on to give a biographical sketch of his career. He attended the Manchester College of Technology, served for six years with High Speed Steel Alloys Ltd., three years as a metallurgist in Burma, and joined the War Office Research Department at Woolwich in 1921. From then onwards much of his work was concerned with the metallurgical aspects of eletrodeposition.

Theory of Nickel Deposition

Dr. Gardam selected certain aspects of Mr. Hothersall's works. He referred to the development of a theory of nickel deposition and said:

"The general picture which the work at Woolwich built up is briefly as follows, although even now it is incomplete in some respects. When current is applied to a nickel solution at a *p*H value on the acid side of about *p*H 6·0, hydrogen ion discharge is initially the only process, but the removal of hydrogen ions from the cathode film raises its *p*H to a sufficient value for basic nickel salts to be precipitated and also makes its potential more negative so that nickel ion discharge occurs, concurrently with some hydrogen ion discharge. The ratio of nickel ion discharge to hydrogen ion discharge is very considerably influenced by the buffering properties of the solution, whilst the physical structure and hardness of the deposit is determined by the effect of the constituents of the solution on the *form* in which the nickel basic salts are precipitated. It seems that these basic materials are invariably in a more or less colloidal and electrically charged form and they are therefore electrophoretically discharged on the cathode. They thus become incorporated in the metallic deposit in a very finely dispersed state, and act, during deposition, to limit the growth of individual grains, and in the solid deposit to stiffen and harden it. Some constituents of solution, notably formate and chloride anions and ammonium cations encourage the colloidal nature of the precipitate and the hardness of the deposit, whilst others such as sulphate anions tend to flocculate the precipitate.

Buffering Properties

"The buffering properties of the solution modify on the one hand the thickness of the cathode film and the dynamic equilibrium *p*H value which the liquid in contact with the cathode assumes, thus affecting the total amount of basic material precipitated, and on the other hand they directly influence the colloidal form and the charge of the basic material. Oxidising materials increase the ease with which hydrogen ions discharge and thus increase the amount of basic material formed so that the deposit is bright and brittle. Organic colloids protect the basic material from flocculation and absorb it, so that they are carried into the deposit, rendering it bright and brittle. No doubt organic brighteners act through their effect on the basic material precipitated in the cathode film.

"Hydrogen atoms or hydrogen gas resulting from hydrogen ion discharge does not itself affect the hardness or properties of the nickel deposit. However, the precipitated basic material can have a pronounced stabilising effect on clinging hydrogen bubbles in some cases which explains the

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propensity of certain nickel solutions to give pits, and the alleviation of this by slightly changing by *increasing* the hydrogen ion discharge, for example,, by lowering the *p*H or adding oxidising agents."

Adhesion of Electrodeposits

Mr. Gardam then made reference to Hothersall's work on the adhesion of electrodeposits, saying:

"Concurrent with fundamental work on the mechanism of nickel deposition, was work on the adhesion of electrodeposits. Adhesion of thick nickel and other electrodeposits to steel was, of course, essential for engineering purposes, and the steels used for armament purposes were usually of complex types and in the heat-treated condition. Hothersall had adopted the process of etching steel anodically at high current density in 30 per cent. sulphuric acid, and had been much impressed by Ollard's quantitative test for the adhesion of thick deposits. He used it for many years as his standard test, and it was in fact, used far more at Woolwich than by Ollard. With this test he showed that the adhesion of sound, thick nickel deposits to steel was very high if the steel had been made passive by anodic action in the sulphuric acid. The fracture was invariably in the weaker of the two metals, so that the true adhesion was not measured, but only the tensile strength of the metal, which the adhesion exceeded. The Ollard test was inconvenient and lengthy for most work and Hothersall standardised and defined a hammer and chisel qualitative test.

"At this time commercial electroplaters were beginning to use chromium plating over an undercoat of nickel and the stress showed only too plainly that the adhesion of the nickel deposit was poor. On steel this was overcome by a strong sulphuric acid anodic etch, but the case of polished brass was more difficult and Hothersall was asked by the B.N.F.M.R.A. to investigate it. In a masterly and elegant research he showed that whereas the adhesion of nickel to machined or filed brass was fairly good, after degreasing only, and was exceptionally good on bright dipped brass, on polished or emeried brass, even when every precaution of degreasing and removing oxide films was taken, the adhesion was so poor that the deposit could be pulled off with the fingers.

"However, the back of the nickel deposit was found to be covered with a thin layer of brass so that the fracture must have been in the upper surface layers of the brass, which had been shattered and disturbed by polishing or emerying. Hothersall showed that this shattered layer was embrittled by the hydrogen discharged during nickel plating and that the trouble could be overcome by a low temperature heat treatment. As, however, this was not usually practicable in commercial practice, he worked out two alternative methods of anodically removing the susceptible layer, the first in cyanide solution and the second in acid ammonium citrate solution. The only defect of the latter was that it formed a very palatable environment for a green mould which grew strongly in it. The etching was so slight and uniform that the polish was hardly impaired. I know that this process was used commercially, but perhaps not widely. However, the lesson was learned. Hothersall also found that the harder steels, even after deep anodic etching, were liable to this hydrogen embrittlement, so that the adhesion of thick nickel deposits was considerably increased by low temperature heat treatment.

Adhesion of Nickel to Nickel

"Often in engineering applications of thick nickel deposits it was not possible to get sufficient thickness in one operation, or power failures caused an interruption, so the problem was constantly arising of how to get adhesion of nickel to nickel. I very well remember Hothersall deciding to investigate this. It was amazing how rapidly he got to the heart of the difficulty. By the simple expedient of observing the manner of formation of a copper deposit when anodically-etched nickel in sulphuric acid was treated at low current density for 30 sec. in a copper sulphate solution, Hothersall showed that the trouble was due to the rapidity with which a clean nickel surface acquired an oxide film even in an acid solution. As in many careful researches, the final practical recommendation was extremely simple:

Adherent nickel deposits could be obtained on nickel by etching it anodically in sulphuric acid and at the last moment, reversing the current momentarily to make the surface cathodic and reduce the oxide film. Practical questions of high adhesion of electrodeposits interested and concerned Hothersall all his working life. Curiously, the best two papers which he published on this subject were presented to American Societies. The practical essence of all this work was embodied in the anonymous series of A.R.D. Electrodeposition memoranda issued during the war.

"Another important research again done for the B.N.F.M.R.A. was the investigation of possible specification adhesion tests for thin decorative nickel deposits. With Leadbeater, he devised the B.N.F. Adhesion test in which the deposit was hammered by a vibrating ball-ended tool for 30 sec. if it was not adherent it blistered. It was found that the test only showed up entire lack of adhesion, but it was written into the British Standard Specification. Hothersall always believed, however, that a partially or poorly adherent deposit was less corrosion-resistant than a highly adherent one, because it offered less resistance to the prising up of the deposit by corrosion at the interface."

Structure of Electrodeposits

Hothersall's investigations towards the science of micro-structure are described, and dealing with his work on the structure of electrodeposits the speaker said:

"It had long been known that soft copper deposits formed on etched metallurgically-produced copper, carried on the structure. This was perhaps not surprising. Hothersall showed that continuation was also obtained on various brasses, silver and nickel, all of which are face *centred* cubic structure, as is copper, and even on β-brass which is body centred. This showed that there was a definite action of the surface atoms of the basis metal in the deposit, and was an explanation of the high adhesion or cohesion of electrodeposits. But in the case of nickel it was more difficult to trace the continuation owing to the rapid reversion of the deposit to its characteristic microstructure.

"In the 1935 paper clear indications of continuation of the structure of iron (ferrite) by electrodeposited nickel were given, but it was not until much later that the most elegant proof was published. This consisted of etching a piece of soft iron, thinly plating it with soft nickel, rinsing and thickly copper plating it. The structure of a cross section did not show the very thin nickel but the grains of the copper deposit exactly corresponded with the grains of the ferrite. The obvious conclusion was that the nickel deposit also continued the structure of the iron. Thus Hothersall's view that adhesion was due to true atomic cohesion between the deposit and the basis metal was miscroscopically justified, but he fully realised that often the structure of the outermost layers of a basis metal were different from the bulk and that the structure of an electrodeposit quickly reverted to its normal form so that in the majority of cases, adhesion was present but continuation of the structure of the basis metal was not apparent. This lead to an unfortunate impression that Hothersall's views were inconsistent with the findings of Finch and his colleagues using the much smaller scale tool of electron diffraction, but I do not think there was any real inconsistency, but only a difference of approach.

"Hothersall was somewhat mistrustful at first of the bright nickel plate, because of its extreme hardness and brittleness, although he appreciated the saving in polishing labour. Jacquet had recently announced anodic brightening so Hothersall reviewed an observation made in the electrolytic stripping of defective nickel deposits in fairly strong sulphuric acid that a brightening action occurred. He developed a process for the anodic brightening of matt nickel deposits, which gave results fully as good as a bright nickel process, without the dangers of brittleness and stress, and went some way to demonstrating its commercial feasibility by pilot scale trials."

Prevention of Corrosion

Other investigations by Hothersall mentioned by the author included the porosity of nickel deposits, the drawing up of specifications and the

engineering applications of heavy nickel, hard chrome and other electrodeposits. He mentioned work which had been carried out by Hothersall on the electrodeposition of tin, and on the question of prevention of corrosion, said:

"Although it is not directly relevant to Hothersall's researches in electrodeposition, it is important to recall that the section he directed at Woolwich was also regarded as the authority on corrosion. In due course this became a subsection under Dr. Clarke, but Hothersall took an active interest in the work and was himself an authority on corrosion and its prevention. He was particularly proud of his well-merited membership of the Corrosion Committee of the Iron and Steel Institute and a number of Service committees.

"When Hothersall visited the United States in 1939, his reception was great, and the American periodical *Metal Industry* said:

"'We have long regarded you as one of the world's keenest students of electrodeposition, and your visit to America was awaited with high expectations. Your presentation of technical data, your discussions on many diverse phases of eletrodeposition, and your charming personality have immeasurably exceeded our expectations. You have won the heart and goodwill of all who have met you... In these times of international stress, the goodwill engendered by your visit is doubly significant in cementing the ties of remaining democratic nations.'"

Conclusions

Dr. Gardam concluded by saying:

"In finally assessing Hothersall's work it is interesting to note that there is no Hothersall test or Hothersall process. What contribution Hothersall made, he made modestly and wished it to be regarded as coming from the Woolwich team. I think it perhaps a pity that he did not write a textbook, in which he would have been freer to integrate his findings than in the isolated papers. One of his most cherished possessions was a bound collection of the ninety-three papers published by himself and his staff in the electrodeposition and corrosion section during his time at Woolwich; thirty-six bearing his own name. Although in a way this was a part of his official work, it was only through his drive and initiative that this contribution was freely made available to the world in general. Many of the other sections did not publish at all, and although in some cases the nature of their work precluded it, in other cases useful results have no doubt remained unknown for lack of the effort needed to prepare them in a suitable form for publication. It is to be hoped that this short appreciation of the main outlines of Hothersall's researches has not been merely a catalogue. Nearly all of these papers are of permanent interest, although many of the ideas expressed in them for the first time have now become the common background of electrodeposition theory. A study of them will surely show that Hothersall's views evolved and developed, and were the result of both a shrewd and penetrating intellect and an infinite capacity for taking pains."

IMPROVING PAINTSHOP PRODUCTIVITY

A FULL report of a conference convened by the Paints Division of Imperial Chemical Industries Ltd. on the 11th June, 1952, is available from the Publicity Department, Imperial Chemical Industries Ltd., Paints Division, Wexham Road, Slough. The titles of the papers are as follows:

"Economic Factors," by Mr. R. G. Hooker, Brush Electrical Engineering Co. Ltd.

"Design of the Product," by Mr. F. C. Ashford, Scott-Ashford Associates Ltd.

"Mechanisation," by Mr. R. M. C. Logan, Chief Chemist, The Van Leer Group.

"Process and Quality Control," by Mr. D. H. Lloyd, Chief Chemist, Fisher and Ludlow Ltd.

High Vacuum Applications.—W. Edwards and Co. (London) Ltd., Worsley Bridge Road, Lower Sydenham, London, S.E.26, announce the opening of new premises at 44 West George Street, Glasgow, where facilities are now available for technical sales and service to meet the growing interest in high vacuum applications in Scotland.

. . . . . the Sales Managers goal at all times, therefore put your products in the lead with Glasso—the finish that protects, beautifies and SELLS ! There's a Glasso finish for every surface . . . . wood, metal, stone . . . . a finish that is easy to apply and economical in use. Let us know your problem we shall be happy to advise.

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INSTITUTE OF METAL FINISHING

Inaugural Banquet

THE Inaugural Banquet (full evening dress and decorations) was held on Wednesday, 22nd October, 1952, with the president, **Mr. H. Silman,** B.Sc., F.R.I.C., A.M.I.Chem.E., F.I.M., as host. There was a formidable toast list!

Lieut.-Gen. Sir Thomas Hutton, general manager of the Anglo-American Council of Productivity, proposed the toast to the Institute, pointing out that he had done the same thing six months previously at the Annual Conference. He took the opportunity of reporting the decease of the Anglo-American Productivity Council, mentioning that the new British Productivity Council would soon be installed and seeking the support of the Institute. He could not say precisely what this new Council would do, for it had not yet met and it was not known exactly what it was to do.

Its primary object was, however, to put into practice throughout Britain the best ideas which were used in the best firms in Britain which, he said, had resulted largely from Productivity Council visits! It would set out to try to persuade the more advanced firms to show their ideas and give lead towards pooled information. He agreed that maybe this was expecting too much of human nature, but thought that it was worth trying. He boosted the results achieved from the Anglo-American Productivity Council visits, and said that the Institute should be prepared to provide experts to advise various firms where they could help. Congratulations were offered by Sir Thomas to Imperial Chemical Industries Ltd. for the publication of their one-day conference in the form of a booklet under the title "Paint Shop Productivity." He expressed the need for finish consultants and concluded by pointing out how the Institute did seek support from industry.

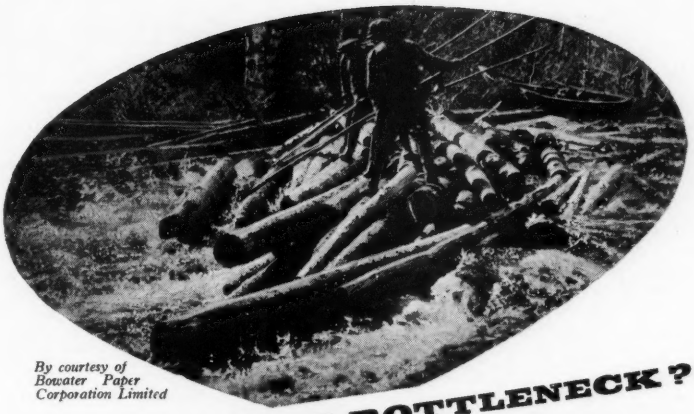
Improved Research

Mr. Silman, responding to the toast, pointed out that the Birmingham Civic heads had their attentions divided between the opening of a dam in North Wales and the Motor Show. He said that at the risk of being described as a revolutionary—for he might wish to go again to America in the near future—he did think that where industry is concerned "all Governments were Socialist Governments." He thought it was necessary that Britain should proceed along the lines of developing an aristocracy of goods, and in that respect finish would sell. He made a plea for improved research and therefore suggested that the Institute should support the research Associations, particularly the British Non-Ferrous Metals Association, within the field covered, but he did think a better calibre of men was needed at the head of research. This led him to suggest that the Institute must show a greater interest in the Universities and vice versa.

He said that during the war the Ministries harnessed resources, but that was a question of where cost mattered little, and they worked on the basis that the trade, in any case, were roguish. In peace-time this policy was fatal—Government Departments had no sense of time, which was scant encouragement to industry to hasten. He concluded by saying that the Civil Service should be kept out of industry as far as possible.

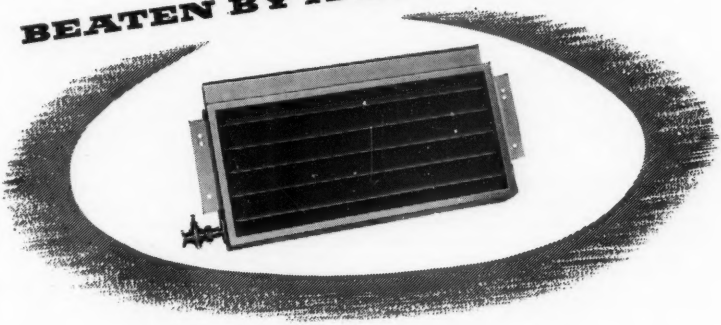
Mr. R. W. Nicol proposed the toast to the Midland Branch, pointing out that Birmingham regularly produces the right man at the right time, either nationally or locally. He mentioned Watt and Joseph Chamberlain, pointing out that members of the Midland Section, Silman and Wallbank, had both fulfilled the office of president with extreme ability. But he did point out that nearly all the prominent citizens of Birmingham hailed from elsewhere—Watt, a Scot, Dixon, a Mancunian, and Chamberlain from the West Country via London, whilst Mr. Silman had come to Birmingham via Sheffield.

The response was by **Mr. W. F. B. Baker,** chairman of the Midland Branch, who said this had been formed in 1933, and regretted that its first chairman, Dr. Cook, was unable to attend because of ill-health. He said that at the beginning the Council of the old E.T.S. viewed the scheme through a critical eye, saying that they would watch its progress and



By courtesy of Bowater Paper Corporation Limited

BEATEN BY A BOTTLENECK?



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if it was successful new centres would be formed. One gathers from a conversation aside that the Council invested £6 in this venture!

The Hothersall Medal

An opportunity was then taken of presenting the Hothersall Medal to Dr. G. E. Gardam, A.R.C.S., F.R.I.C., F.I.M., who had presented the first Hothersall lecture in the afternoon, and the Westinghouse Brake and Signal Co.'s prize to Mr. W. A. Marshall, A.I.M. In mentioning the latter, Mr. Silman said that it was odd that the Westinghouse prize, coming from a firm primarily engaged in the manufacture of rectifiers, should have been awarded for a process which did not use an electric current—a hydrogen peroxide/oxalic smoothing solution for steel.

Dr. S. Wernick proposed the toast to the metal finishing industry and in response **Mr. K. G. Kent,** managing director of Cruickshanks Ltd., said that he was pleased that the old days of black magic were disappearing in the plating industry. On the other hand, he did say that designers were tending to cause a spot of trouble, and thought a short course for them in gum-boots in the plating shop might help. He thought that although Sir Thomas Hutton had said much in praise of America by suggestion, nevertheless the American finish was lower than that in Britain, but there again the services from the American supply houses were much greater. He pointed out that Dr. Wernick had been honorary secretary of the Institute for the past twenty-five years, except for the two years when he held the office of president.

Dr. J. W. Cuthbertson, of the Tin Research Institute, proposed the toast to the guests, mentioning specifically Dr. Pfeil, of the Mond Nickel Co. Ltd.; Mr. H. E. Jackson, of Imperial Chemical Industries Ltd.; and the President of the British Non-Ferrous Metals Research Association.

In conclusion, **Dr. Ellingham,** secretary of the Royal Institute of Chemistry, responded for the guests.

ELECTRIC FURNACE COMPANY, LIMITED

THE Chairman, Mr. D. F. Campbell, at the 24th annual general meeting on 25th September, 1952 said:

The consolidated profit and loss account for the financial year 1951-1952 shows a profit of £101,276; of this sum, income-tax, profits and excess profits taxation takes £49,191. After placing £25,000 to reserve in the holding company and £15,000 in the subsidiaries, the directors propose a final dividend of 5½ per cent. less tax on both classes of shares, making 10 per cent. for the financial year, leaving £17,837 to be carried forward.

During the period under review, the improved outlook of the Electro-Chemical Engineering Co. Ltd., a wholly-owned subsidiary, is remarkable and the debit on its profit and loss account has been converted into a credit. The company's progress both in regard to home orders and export trade, especially to Germany, Italy and Australia, has been highly satisfactory.

Revenue has also been reduced by the sale of a small steelworks previously let at a substantial rental. The profit on this transaction is included in the sum placed to capital reserve.

Our subsidiary company dealing with resistance furnaces has had a most successful year and has contributed largely to this year's profit. The Lindberg cyclone principle of air circulation for heat treatment has proved of great value and a number of very large equipments have been installed for the heat treatment of light alloys.

Technical collaboration with our associates in the U.S.A. has been cordial and mutually advantageous in all three branches of our activities.

During the year, plans were made to form, at the end of the financial year, a new wholly-owned subsidiary company, the EFCO Engineering Co. Ltd., to operate the manufacturing side of our Burton Works. The company has now been incorporated and commenced trading on the 25th April, and the directors appointed to its Board are Messrs. W. S. Gifford, W. J. Millar and D. N. Gifford.

It is the policy of your directors to correlate as closely as possible the activities of the various branches of your business, and to this end Mr. J. A. Monks has been appointed an additional managing director, and it is now proposed that Mr. A. Smart, who has been responsible for the activities of the Electro-Chemical Engineering branch of your business, be elected to the Board of the Electric Furnace Co. Ltd.

Three New Finishes.—Metal Processes Ltd., 758/786 Kingsbury Road, Erdington, Birmingham 24, announce three new finishes for brass, bronze and copper.

WRINKLE FINISHING

by

FRANK SPICER

THE versatile effects of wrinkle finish are too well known to be discussed at great length, and although the familiar pattern is widely used, some manufacturers still fight shy of it. They often think that it is difficult to apply or too expensive; of course, this is far from the truth, wrinkle finish being one of the easiest organic coatings to control.

Three factors are of vital importance in the application of wrinkle finish; these are:

(a) A clean gun nozzle.
(b) Uniform heat throughout the process.
(c) Common sense.

The coating itself has many advantages; to name a few:

(1) The operator does not have to exercise as much care to prevent sagging.
(2) Dust contamination does not have such a deleterious effect as when applying other finishes.
(3) Faults in the finished surface are not so apparent.
(4) It is a one-coat job.
(5) It can be used on inferior base quality material.

The uses to which wrinkle finishing can be applied are almost unlimited; it can be found on typewriters, clocks, cookers, lamp desks, etc., and it can be obtained in many colours and combinations. One manufacturer of a typewriter has achieved an attractive and distinctive finish on his product, dove grey predominating and relieved by patches of red on moving parts such as the carriage, etc.

Another type is that of opalescence wrinkle, produced by adding opalescent materials to the basic wrinkle formulation to give a varied colour effect when struck at a tangent by light.

The final choice of which "wrinkle" to apply depends essentially upon the design of the product to be processed, and the particular colour and texture to be used, e.g., whether it is to be uniform wrinkle, birdseye wrinkle, pine tree and sag wrinkle. With the exception of birdseye, these are all a one-coat application—the birdseye requires two—the first is a preliminary treatment at 100° F. to develop and set the eyes, followed by one at normal temperature, to harden and set the film.

Of the other colours, the most widely used is black, followed by green, although the brighter colours and even pastel shades are becoming popular, although during the stoving of the latter the temperature must be closely controlled, otherwise they tend to burn.

Another type of wrinkle is that of clear or unpigmented wrinkle; this enables large quantities of components, where the colour is varied in accordance with the whims of the customer, locality, or country. When sprayed they can be placed in stock and withdrawn as required and given a coat of pigment enamel.

Application

Wrinkle can be applied by brushing, dipping, spraying or roller coating; spraying is the most widely used of these, and is also the most effective, although where the quantity of production warrants it, electro-static methods may prove satisfactory.

The characteristics of a good wrinkle enamel should be as follows:

(1) Easily applied.
(2) The formulation should allow fast and low temperature stoving times.
(3) Be uniform in texture.
(4) Possess good covering power.
(5) Give a good hard washable finish.
(6) Be as dust-free as possible.

Its physical properties are many and to outline all of them would take much time and space. The main features of a wrinkle finish are: good adhesion, durability, hiding power, light absorption, etc.

Adhesion

In the main, all that is required is a clean dry surface, which can be obtained in a variety of ways, depending upon the type and condition of the material as it is received. A shiny smooth surface may require a "keying" operation, which is simply a chemical treatment. One authority recommends the use of ethylene dichloride or phosphoric acid solutions.

Surfaces possessing suction-like characteristics, ie., have a porous surface such as that possessed by fabric, paper or wood, usually need a primer coat to prevent undue absorption of the varnish, which would prevent the formation of the wrinkle pattern.

Durability

Its durability is brought about by its remarkable adhesion and toughness, and allows it to be handled with less care than that usually shown to painted surfaces.

Hiding Power

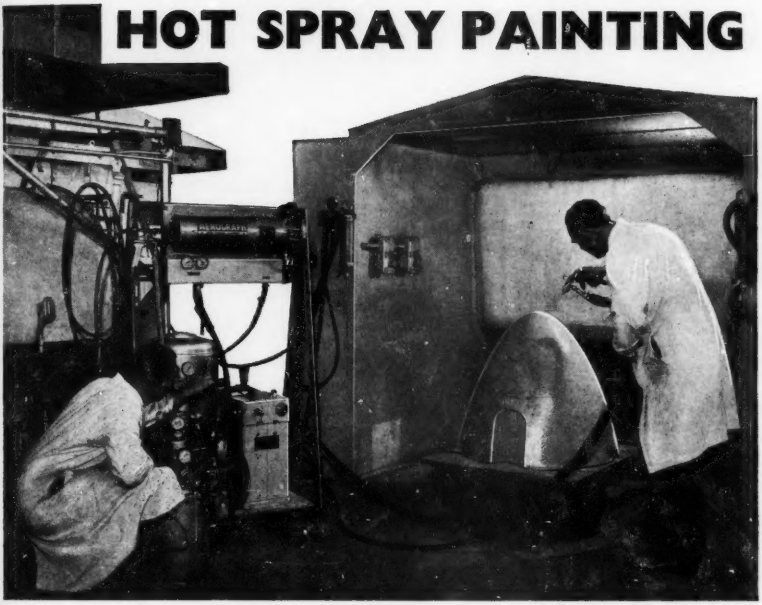
The ability of a wrinkle finish to hide a scruffed surface, or even a spot-welded surface, give to it a place of utmost importance in the finishing world.

Light Absorbing Ability

The surface of wrinkle, with its many facets, reflects light at all angles and the glare resulting from most surfaces is dissipated. This is important in instrument finishing, likewise is its ability to provide a slip-free surface where instruments such as pyrometers, typewriters, cameras, binoculars, etc., are being constantly handled. A further quality claimed for wrinkle is due to the constitution of the film, which creates a larger surface area on such articles as electric motors; this extra surface has proved its ability to dissipate heat.

Rosista, a special chemical-resistant paint from the range of Sir W. A. Rose and Co. Ltd., has been used to paint an artificial fertiliser distributor, as shown above, produced by Taskers of Andover (1932) Ltd., Anna Valley, near Andover

HOT SPRAY PAINTING



How to Control the Finish—from the Start

The great advantages of Hot Spray painting are only just being realised. For many industrial purposes the use of the pre-heating process will give an excellent finish much more quickly, with less labour and with an appreciable saving in cost.

For those who want to know more about it, the Demonstration Centre offers full facilities for practical demonstrations on customers' own products. What is more, we will gladly train paint-shop operatives at specially arranged short intensive courses—at no cost or obligation to the customer.

This is *your* opportunity to gain impartial and unbiased advice on the process that is revolutionising many industrial finishing procedures. If the process is suitable for *your* product, we will show you how best to use it. If it is *not* suitable we will save you expensive "trial and error".

The photograph shows a corner of the Demonstration Centre with operators hot-spraying synthetic enamels at the water-washed spray-booth. Three types of paint heaters are shown in the illustration. Take advantage of this "know-how" and let us help you to *control* your finish.

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Setting-up a Generator for Plating Purposes

(SPECIALLY CONTRIBUTED)

WHILE details for the setting up of a generator for plating purposes are usually given by the makers, not a few practical features have to be met to ensure best results where the particular instaliation has to be made. When the initial selection is made, it has to be remembered that the higher the speed, the less will be the cost. The direction in which the generator runs is important, since generally it will only excite in the one direction, and although by changing-over the leads from armature to field makes reversing possible, this only adds unnecessarily to the work. Where the machine is a motor generator, and direct-current available for driving, the voltage is stated, and where alternating, the voltage, frequency in cycles per second, and phase are quoted. Two-phase current is occasionally used, but three-phase is almost universal.

Where belt driven, the speed of the line-shaft or driving motor to which it is connected is ascertained, and also if this line-shaft is sufficiently strong to obviate any whipping action when transmitting the extra power. There should be enough clearance between ceiling and shaft to take the standard pulley supplied by the maker, to drive the generator at the required speed, and not depend on some special make.

Excessive slip and belt wear will result from using too small a pulley. Where the generator is motor-driven, the motor must be sufficiently powerful to handle the load without overheating tendencies.

Multiplying the number of kilowatts marked on the generator name-plate by 1·33, and adding 30 per cent. extra for losses in the motor, generator and belting, may be taken as a rough estimate.

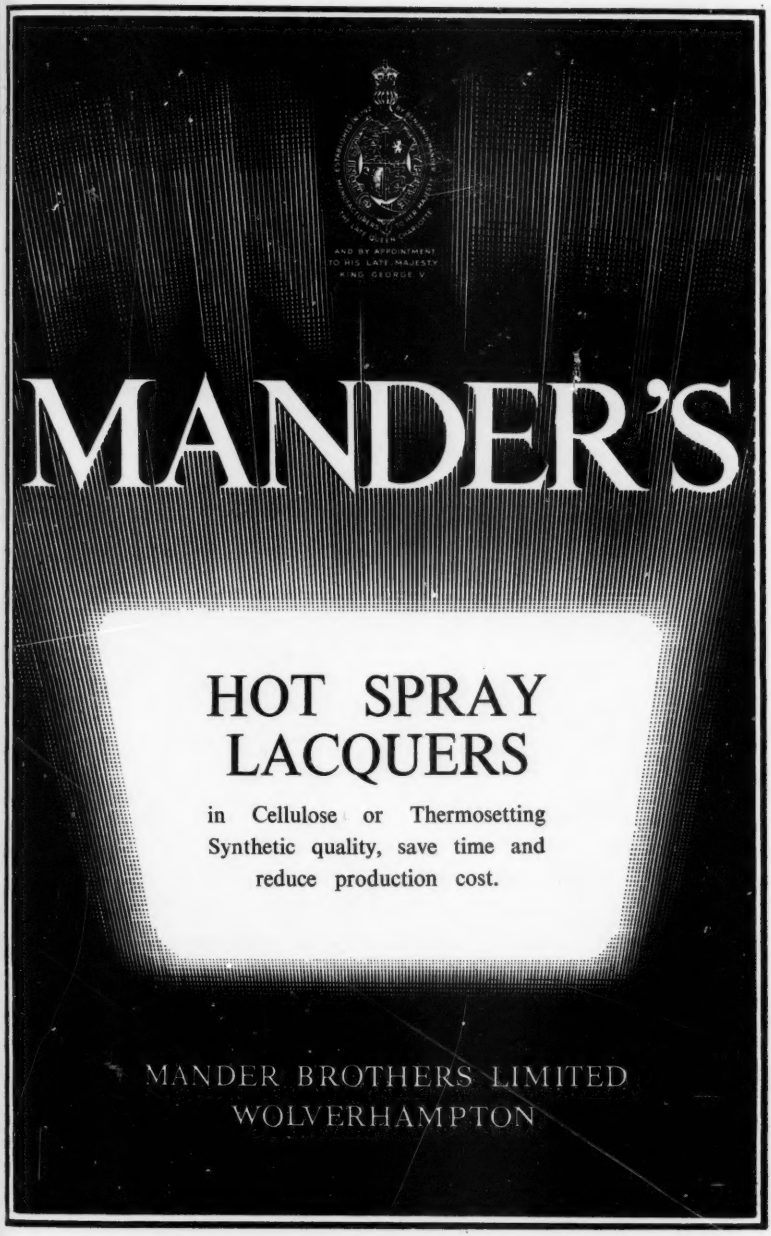
Features of the Machine

Regarding the machine itself, it is desirable to note if a field rheostat for adjusting the voltage on the generator itself is necessary, and how wide must be this regulation. A double-commutator machine will be more efficient where one voltage is approximately half that of the other, or where the voltages for different tanks require approximately the same difference. It is unnecessary to reduce the higher voltage to the lower voltage through tank-resistances, which are power-wasting. For high voltage, the two armature windings are merely connected in series, and in parallel for low voltage, while on the tank rheostats only minor adjustments are made. An alternative to this is to use the familiar three-wire connecting system.

Ensure Tight Connections

A further feature in favour of the double-commutator machine is that it is impractical to reduce the voltage below 25 per cent. of normal by means of a field rheostat, since at this point the weakened field is liable, with varying load, to cause unsteady voltage. Failure to excite, and unsteady voltage in some instances, may be traced to a field wire or cable which is not making proper connection, and which is most likely to occur where the field is connected to a brush-rocker. It is particularly important to ensure tight connections at all points of the circuit in plating generators, because of the low voltages and high currents formed. An amount which would make little difference in a 110 v. motor, such as a drop of even 0·5 v., can inflict havoc with tank results. It might prevent the generator from exciting at all in extreme cases.

When the generator gives only about 2 or 3 per cent. of normal voltages when running at normal speed, this is probably due to a complete break in the field circuit. There may be a short-circuit in the field or armature if more than this, but less than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normal. Appreciable sparking will, of course, take place on all brushes, while the commutator will show burnt spots in this instance.

Investigations Before Starting

When the generator has arrived, and everything is ready to start, the oil wells should be thoroughly washed out with paraffin oil to remove grit and dust, and after removing all traces of this oil, filled up with suitable lubricant. Where the bearings are of the sleeve type, the shaft should be turned over by hand to see that the oil rings pick up the oil properly, with no sticking tendency. With ball bearings, which generally come ready packed with grease, this should simply be inspected, and a refill is usually only required every six months, or after a year's use. The fresh generator is then run for half-an-hour or more without load, and if there are any signs of sparking, each brush must be lifted out to see that it is bedding all over properly.

After checking pigtails for good connection, the brush springs are set to the pressure recommended in tables supplied by the makers. Should these tables be lacking, the pressure should be set as lightly as possible, consistent with absence of sparking and good contact on the commutator. There is always the remote possibiity that the brush rocker may have shifted since the generator was on test at the factory, and which necessitates checking. It must be remembered in setting the rockers on a double commutator machine, that as both windings are on the same armature, any error on one brush rocker setting will affect the other. To rectify, the full output from one side only is taken, and that rocker adjusted until it does not spark, followed by adjusting the machine with the load on the other side only. With both rockers correctly set for their own loads, when load is applied to both sides at once, they will not upset the performance of each other.

In the three-wire system of tank connection, the middle wire need not be nearly so heavy as the other two, and, as can be understood, if the loads between the middle and the two outer cables are equal, the middle wire will carry no current at all. In any case, it will only have to carry the difference between the two sets of tank loads, which may be made as small as possible. This is a large saving in cost of installation with the heavy currents to be handled in plating.

Finally, while wooden foundations of ample size are quite popular, they compress more than does concrete, but whatever base is used, this should be somewhat above floor level, so that dust cannot get swept under the generator. Concrete provides the most solid foundation, and forestalls vibration, which in turn sets up sparking, and ultimate damage to the electrical windings. Ready-mixed concrete can frequently be purchased, but failing which, one bag of cement to 4 c. ft. of crushed stone, and 2 c. ft. of clean, sharp sand, thoroughly mixed, will usually suffice. Each anchor bolt should carry a loosely-fitting tube of about three times the diameter of the bolt itself, to permit a certain amount of freedom of movement, so that minor errors of line-up with the driving pulley can be adjusted after the concrete base has set finally.

BIRMINGHAM PAINT VARNISH & LACQUER CLUB

THE winter session of the above Club opened on Thursday, 2nd October, 1952, at the Imperial Hotel.

"The Properties of Nitrogen Resin Finishes containing various Alkyds" was the title of a talk given by Mr. L. R. Rogers, B.Sc. (I.C.I. Ltd., Dyestuffs Division) which proved extremely interesting to members, as the main portion was devoted to the recent research by the lecturer and his colleagues on the causes of gas checking.

The members showed their appreciation of this very fine lecture by enjoying one of the longest discussions ever known in the Club.

"The Bonderizer."—In *The Bonderizer* for October, 1952, published by the Pyrene Co. Ltd., Metal Finishing Division, Great West Road, Brentford, Middlesex, are details of instruments by Negretti and Zambra protected by "Pylumin," together with notes on the Trianco automatic boiler by Trianco Ltd., and loudspeakers by Reproducers and Amplifiers Ltd., both of which are protected by "Bonderizing."

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Electrostatic Finishing

by

A. L. PHILLIPS
(New York)

"PRODUCTION has increased over 300 per cent. over previous synthetic enamel hand-spray methods. A drop of from 20 per cent. to 5 per cent. in the number of rejects has been achieved. The number of pieces per gal. of paint has been increased from an average of forty to 127 pieces per gal."

This is the report from the paint supervisor of a Californian company after changing from hand-spraying to electrostatic deposition.

This system can be used economically wherever the volume justifies the use of a conveyorised finishing operation. It obviously would be uneconomical to install expensive mechanical equipment where the production volume would be too small to ensure continuous use.

Scope

All metallic objects may be finished with this equipment, but non-metallics such as glass, wood, rubber, pottery, and plastics, require a temporary false backing of metal during the finishing operation.

Any material which can be atomised successfully may be used. Enamels, lacquers, oils, water-soluble materials and waxes are handled with equal facility.

Existing conveyors—monorail, overhead, spindle, or belt type—may be used with little change or modification.

The material is sprayed at a minimum air pressure. Excessive pressure would defeat the whole object as deposition relies upon electrostatic attraction and not upon compressed air projection. The pressures, therefore, are kept extremely low; the fluid pressure being approximately 5 p.s.i. and the atomising pressure about 20 p.s.i. The air requirements thus are easily met. The pressures are controlled accurately by means of gauges supplied with the equipment.

The speed of the conveyor can be synchronised with production schedules and may be operated within a wide range. Speeds presently in use vary from 3 ft. per min. to as much as 800 ft. per min.

In normal operation the power requirements are low. The unit draws only 4 amp. and consumes less power than one 1,000 watt lamp. Unless special equipment is necessary, the unit is built to operate from 220 v., 60 cycles, single-phase, A.C. lines. Where this type of supply is not available, units can be furnished to operate from existing sources of supply.

The velocity of booth exhaust systems is usually reduced because excessive suction when low atomisation is used would tend to interfere with particle deposition.

Electrostatic Coating

The principle involved is that of unlike electrical charges causing attraction. The atomised particles of paint are brought within the influence of an electrostatic field. This is why the lowest possible pressure of air is used. The object is to introduce the paint particles to the electrical field with sufficient energy to be travelling in the general direction of the product to be coated. When they come within the influence of the force of attraction they will be deflected from their course and attracted on to the product. If their velocity is too great the force of attraction will be less than the force of propulsion and over-spray will result.

In the spray booth, the electrode consists of fine wires arranged on each side of the conveyor. Products to be coated are supported by work holders, the shape of which is governed by the type and design of the article. Automatic spray guns are positioned at the face of the booth to spray the coating material in a direction approximately

parallel to the path of travel of the conveyor.

The electrode system is charged to a high potential and the conveyor is grounded. This means that the products conveyed are at ground potential and an electrostatic field is created between the electrodes and the grounded products. The material is sprayed into this electrostatic field and receives a negative charge. The opposite polarity of the grounded articles causes a strong force of attraction to be exerted upon the negatively charged paint particles which leap in the direction of the products and adhere to them.

This force manifests itself in some unusual ways. The attraction is so great that some of the paint particles reverse their direction of travel as much as 180°. This feature, which is termed "wrap around," is responsible for the coating of those areas so difficult to finish by conventional means. Edges, and other difficult surfaces that have to be finished manually with most automatic systems, receive a perfect coating in the one operation.

Another feature of this system is the reduction of over-spray. The material is directed down the line of articles and most of it is attracted to the product. When hand-spraying, the atomising pressure is so great that a large quantity of material overshoots the mark or is lost at the end of each pass. The trigger is pressed before the spray gun is in line with the product, and is not released until the nozzle is past the coating surface. Thus, at the beginning and end of each pass, a percentage of material is lost. In the course of a single day a great deal of material is lost by this means alone.

The system of electrostatic paint spraying has been adopted widely; it is not the complete answer to every problem, but it is a highly efficient means of coating products that lend themselves to high-speed automatic operations.

New Development

The principle involved in one of the latest developments is the same, but a new and radically different spray head is used.

It operates without the use of compressed air. There is no propelling force whatsoever.

The conveyor is grounded to keep the products at ground potential, and the other terminal is connected to the spray head. The electrostatic field is no longer a "grid," but the space between the spray head and the products.

This head is carrying an exceedingly high potential which is seekng to ground itself, and as the product approaches the sphere of influence it actually draws the paint to itself in the form of a fine spray. There is no over-spray. There cannot be any, because the product is the magnet that draws the paint to itself. Once the product is beyond the range of attraction, the spray ceases because there is no propelling force behind the spray.

Spray Head

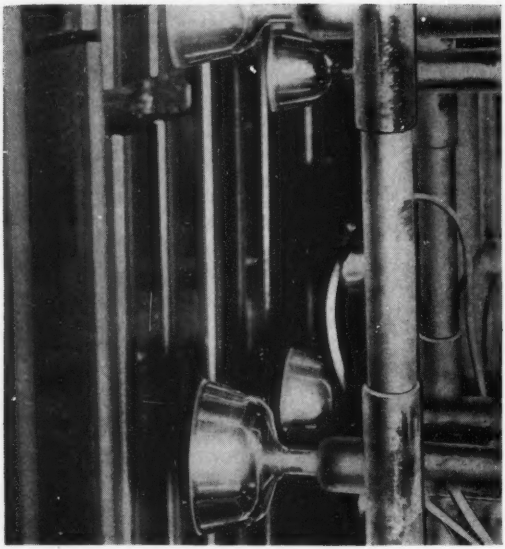
The cup-shaped spray head is a hollow cone and the coating material is metered at a predetermined rate to the apex of the head. The paint is spread evenly over the inner surface by rotating the spray head and this allows an even flow to the outer edge. A thin film of paint thus covers the inner face of the cone, and as paint is attracted by the product, more material is fed from the source of supply.

The lack of over-spray is in itself an interesting feature; an efficiency of 99 per cent. is claimed, and this immediately reduces some of the problems and much of the expense involved in finishing operations.

The variables associated with the use of a spray gun are reduced because the product determines the spray pattern. If a small product follows a large one on the conveyor, the spray pattern can be seen to tighten to conform to the reduced area of attraction. No compressed air is used, so there is no atomising pressure problem, and no spray nozzle adjustments to be made.

The conventional spray booth disappears, and paint reclamation is unnecessary because there is no paint to reclaim. The air is no longer saturated with paint particles, so the usual exhaust system can be replaced with a simple form of ventilation to remove the solvent vapours.

The use of this spray head reduces



Close-up of the new electrostatic atomizing spray heads. Note the varying contours of the steel sheets, which are painted at an average rate of 15,000 sq. ft. per hour.

(Courtesy, Ransburg Electro-Coating Corporation, Indianapolis 7, Indiana, U.S.A.)

at one stroke, operational costs, maintenance work, and space requirements.

Uniformity, and positive duplication of results, are not functions of the human element; they are functions of machinery, where the variables associated with the degrees of human skill are reduced to a minimum. The skill of the man behind the spray gun will be reflected in the finish obtained, and may vary with the health and state of mind of the operator.

The training necessary to operate this completely automatic system may be counted in minutes against the days or weeks required to train a spray painter.

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A voltage of approximately 90,000 is used, but the amperage is so small that the danger to personnel is claimed to be non-existant. Extensive tests were carried out upon animals to determine the result of contact with this high voltage. It was found that no ill effects were discernable after repeated exposure.

The heat of the spark is relatively low and below the flash-point of much of the material used. To reduce the hazards still further, three separate devices have been incorporated into the design, each of which is sufficient to cut off the supply of power should a fault develop.

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The advantages claimed by the manufacturers are: increased efficiency, reduction of labour, no spray booths required, no over-spray, no paint to reclaim, cleaning and maintenance reduced to a minimum, exhaust system replaced by adequate ventilation, no compressed air necessary, training reduced to minutes, push-button control and little skill required, positive duplication of results week after week or until the production run is ended.

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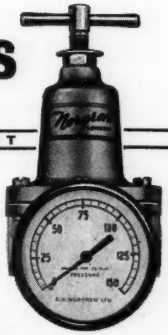

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M-W.107

(*Continued from "Industrial Finishing," October, 1952*)

Application of Plastics in Industrial Fabrications, Linings and Coatings

by

V. EVANS, M.Sc., A.R.I.C., A.P.I.
(Special Director and Chief Chemist, Prodorite Limited)

Phenol Formaldehyde Resins

IT is not surprising that the chemically-resistant properties of the phenol-formaldehyde resins have led to their application for lining vessels and plant. Normally the resins are applied in the form of a lacquer prepared from a lacquer prepared from a phenol-formaldehyde resin condensed to the resol stage only and dissolved in suitable solvents, so that application can be made by spraying, brushing or even, in special cases, dipping.

These coatings are normally used with metal surfaces only, and very great care and attention is necessary to obtain good results. The metal surface has to be shot-blasted or sand-blasted immediately prior to the lacquer application, so that a really clean, etched surface is obtained; this helps the adhesion of the coating. Several separate coats of lacquer are applied; frequently inert pigments are incorporated in the lacquer, but the last few coats are normally impregnated to give a good gloss finish. General practice is to give a final thickness of some 5 to 10 mil.

Although cold curing coatings of this type can be formulated by the addition of acid catalysts to the lacquer, they are not so satisfactory as stoved and baked coatings. The acid catalysed coats are not so tough as the stoved coatings and are also prone to embrittlement. On the other hand, by careful control of the stoving schedules, it is possible to produce tough, hard finishes of attractive appearance, excellent durability and good chemical resistance. These coatings have good resistance to many acids, both inorganic and organic, to solvents and to mild alkalis. They are unsuited for use in contact with caustic alkalis and oxidising acids. Although these coatings have such excellent chemical resistance, they are mainly used in practice for the milder types of chemical conditions owing to the risk of accidental mechanical damage to the lining, leading to severe corrosion of the base metal. Nevertheless, these coatings have been very widely used for the lining of tanks, vessels, trays, filter plates, ducting and the like, particularly in the foodstuff, beverage and pharmaceutical industries and other mild corrosive conditions. Owing to their very clean, glossy surfaces they are also frequently used in cases where the product has to be kept free from metallic and other contamination.[18]

Epon or Epikote Resins

Many attempts have been made to increase the flexibility and toughness of the phenol-formaldehyde resin linings, but so far little success has been achieved. The use of plasticisers has not been very hopeful, and the most promising line of development appears to be in the modification of the resin molecule to give internal plasticisation. One very interesting development has been the introduction of the so-called Epon or Epikote resins. These resins are prepared from the condensation of bisphenol—prepared from phenol and acetone—and epichlorhydrin. The resins are

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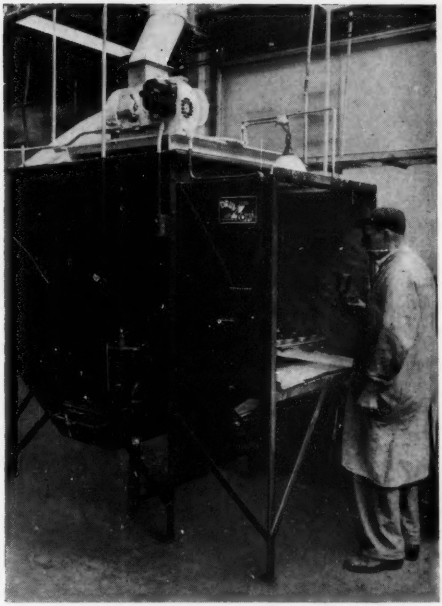

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essentially linear molecules which can be cross-linked by reaction with other resins, including phenolics. By this means a product is obtained which can be applied as a coating, and which is very tough and chemically resistant, but at the same time is remarkably flexible. One disadvantage of this type of resin is the need for a high stoving temperature of about 210° C., but these resins undoubtedly mark an interesting development in this field.[19]

Coatings based on synthetic resins prepared from furfuryl alcohol have been developed, but little use appears to have been made of them in this country. Their application and general properties are somewhat analagous to phenol-formaldehyde resin coatings, but they are, in addition, resistant to concentrated caustic alkalis. Furfuryl alcohol resin coatings are black or dark grey colour and this may be a slight disadvantage for certain applications.

Polytetrafluorethylene, with its unique chemical and thermal resistance, will provide a useful lining material if a suitable technique for application as a coating can be devised. Reports have been received on the use of dispersions of this polymer in organic solvents which are sprayed on to the surface to be coated and then fused by stoving to a temperature of 400° C., but so far little actual practical use has been mentioned. The polymer Polytrifluorochlorethylene has almost the same good chemical resistance as Polytetrafluorethylene, but is a little less difficult to work. In spite of their high cost wide use will undoubtedly be made of these polymers as surface coating materials if suitable application techniques can be worked out.[20, 21]

Polyurethanes

Another interesting development in the coating field is provided by the Polyurethanes. Originally investigated in Germany, considerable attention has now been given to these materials both in America and this country. Essentially they are formed by reaction of isocyanates with compounds or synthetic resins containing reactive hydrogen atoms. This reaction takes place at normal temperatures, resulting in the formation of polymeric materials without requiring any addition of any catalyst, and normally requiring no stoving. The coatings obtained in this way have good chemical resistance to both moderate strengths of acids and alkalis and to many solvents. They are also more flexible than the phenol formaldehyde resin coatings. Undoubtedly, this development will provide a very useful type of coating, particularly in cases where stoving is difficult or impossible to carry out.[22]

Plastisols

By using P.V.C. or P.V.C.-P.V.A. (Polyvinyl acetate) co-polymers dispersed in plasticisers, products are obtained known as plastisols. They are viscous, creamy pastes, and by dipping articles into these pastes, very substantial, tough coatings of appreciable thickness are obtained. Articles are cleaned by shot-blasting or other means, and then coated with a special primer; after the primer has dried, the articles are heated to 140°-150° C., and these plunged, while hot, into the plastisol paste. This allows a substantial coating to be retained, and after draining the article is stoved at 150°-190° C., in order to "fuse" the coating.

This "fusing" process is, in effect, the complete solution of the co-polymer in the plasticiser at the elevated temperature. Coatings of this type are tough, flexible and will withstand a wide range of chemicals and also considerable mechanical wear and tear. Consequently they have found wide employment for electroplating jigs, dipping and pickling baskets, stirrers, and an assortment of small articles requiring protection against chemical attack.

Polythene, in the form of a fine powder, has been used with the various types of flame-spraying guns or pistols, giving a fused coat of Polythene on to the article being sprayed. In practice, results have not been very successful, probably due to degradation of the Polythene whilst passing through the flame of the gun. An alternative method of application has now been introduced and has given much better results. In this method the article to be coated is heated to a temperature just above the softening point of Polythene, and then sprayed with, and dipped into,

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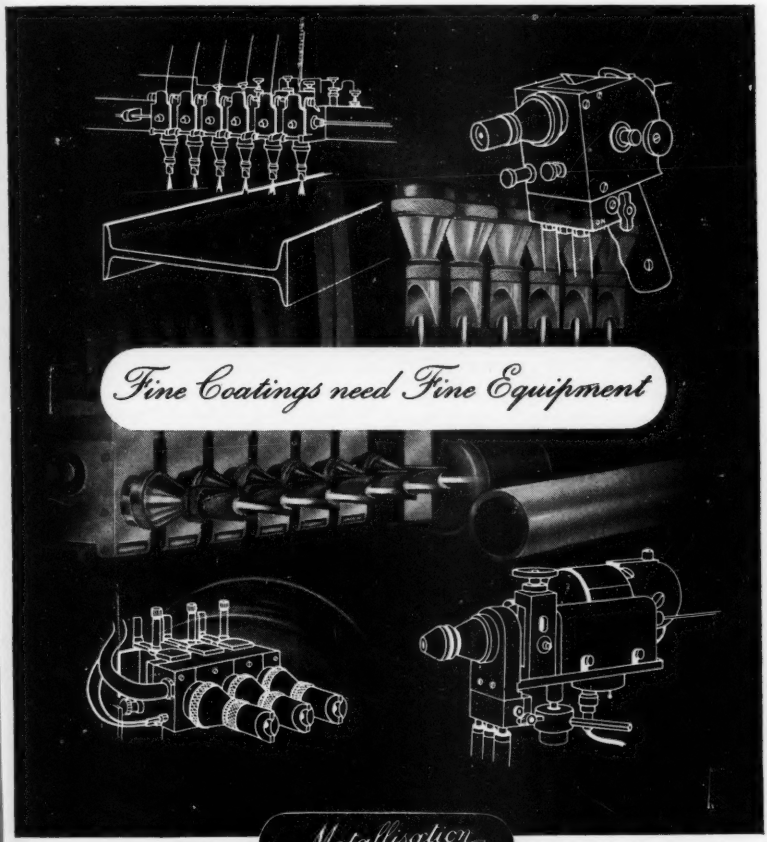

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cold powdered Polythene; the article is then carefully stoved to effect complete fusion of the adhering Polythene. Electroplating jigs and other small equipment have been coated by this means with quite good results.[23]

Paints and Varnishes

Turning towards materials such as paint and varnishes, plastics have, of course, made very important contributions to this field, but such a vast subject requires a complete article in itself, and consideration will be limited to two materials which provide coatings of plastic material entirely as compared with many varnishes and paints which, although making use of plastics, are essentially drying oil type coatings.

The first type of coating is based on the use of P.V.C.-P.V.A. co-polymers containing about 14 per cent. of P.V.A. The co-polymers are dissolved in suitable solvents and usually include plasticisers such as di-octyl phthalate. Usually pigments are used in the base coats, but the last coat or coats are usually unpigmented in order to give a good gloss finish. Primers are frequently made use of containing special co-polymers which aid adhesion to the metal surface.

Finishes formulated on these lines give very chemically-resistant coatings, but it cannot be emphasised too strongly that application must be made to really clean surfaces. The finishes are relatively expensive and it is clearly a waste of materials and labour if the application is made to rusty or dirty metal work. They can also be applied to good, smooth concrete surfaces. Apart from their application to exteriors of plant, structural steel work, etc., they can also be very successfully used as linings to vessels or tanks for very mild chemical conditions such as wash and rinse tanks after acid dipping processes.

The second material to be considered in this section are coatings based on silicones. These are polymers based on the products of controlled hydrolysis of the organochlorsilanes, and for surface coating applications they are usually dissolved in aromatic hydrocarbon solvents such as benzene, toluene or solvent naphtha. Pigments are usually incorporated into the formulations, but as one of the chief applications for these coatings is for heat-resisting purposes, it is essential to select heat-resisting pigments, such as aluminium powder, titanium dioxide, lithopone or zinc oxide. In order to obtain maximum heat resistance, stoving for several hours at temperatures in the range 200°-250° C. is necessary and, as this is rather difficult to arrange in many cases, it is often possible to carry out "in situ" stovings.

Objects such as metal chimney stacks or stove pipes are coated externally with a silicone finish, whilst cold, and when the coating has dried by solvent evaporation, final curing is obtained by the heat available from the normal operation of the plant. Silicone coatings will successfully withstand continuous temperatures in the range 200°-250° C. They have quite good resistance to acids and alkaline, but their solvent resistance is poor. Their main application, at present, is for heat-resisting coatings.[24]

Corrosion-resisting Cements

Finally, very brief consideration will be given to the help given by plastics in the corrosion-resisting cement sphere. By the use of certain synthetic resin, cements are now available which provide complete resistance to caustic and mild alkalis, in addition to acids, whereas silicate cements, hitherto the most used type, are resistant to acids only. Other valuable features of the synthetic resin cements are their improved mechanical properties, such as tensile and compressive strengths, their good resistance to erosion, and their non-porous character. Cements of this type are normally used for the bonding and setting of corrosion-resistant constructional units such as bricks, paviors, channel blocks, tiles and the like in the carrying out of flooring, drainage channels and linings to vessels and tanks. It must be pointed out that in cases of suspended floors, drainage channels and linings, that it is usually essential to incorporate an impervious membrane behind the brick or tile lining. This membrane takes care of any leakage caused by cracks which may develop in the brickwork due to any structural movement or movement due to thermal expansion and to any imperfectly

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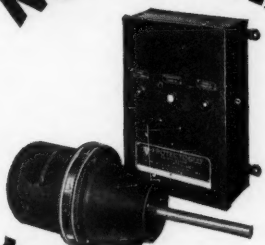

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filled joints in the brick or tile lining, but this point has already been discussed earlier, in the section on linings.

Three main types of synthetic resin cements are largely used in this field, those based on phenol-formaldehyde, furane and cashew nut shell liquid (C.N.S.L.) resins respectively. They all comprise essentially a resin syrup which is mixed with an inert filler containing an accelerator for further condensation of the resin. In this, manner, suitable mortars are obtained which are self-setting and can be used much in the same way as a sand-Portland cement mortar.

The phenol-formaldehyde resin cements are resistant to most inorganic and organic acids but only to very dilute oxidising acids, to mild alkalis and to many solvents. Special cements of this type have been developed which, after fully curing, are resistant to strong alkalis. Furane resin cements are resistant to most inorganic and organic acids, but their use with oxidising acids is not advised; on the other hand, complete resistance to practically all alkalis (caustic and mild) and solvents is provided. The C.N.S.L. resin cements are resistant to most inorganic and many organic acids and have better resistance to oxidising acids, such as nitric acid, than previous types of cement discussed. After some heat treatment they resist mild and caustic alkalis but their solvent resistance is poor. They have very good resistance to mixtures of nitric and hydrofluoric acids such as are used for the descaling of stainless steels and have been successfully used for bonding carbon bricks in the construction of tanks for this purpose. All these cements can, in general, be used at temperatures up to 170°-180° C.[25, 26, 27, 28]

In conclusion, it is suggested that, owing to the variety and complexity of the plastic materials available, that the advice of specialists are sought. Most specialist firms are willing to offer expert advice and help on problems submitted for their consideration in these fields.

The author would like to express his thanks to the directors of Prodorite Ltd., for permission to publish this article.

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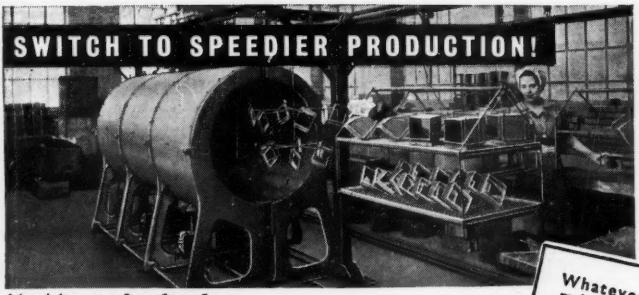
INDUSTRIAL DRYING

IN publication No. 4,706, Sturtevant Engineering Co. Ltd., Southern House, Cannon Street, London, E.C.4, have a booklet dealing with the various kinds of drying in industry. The book gives illustrations of drying of fabrics, ceramics, confectionery, vitreous enamel, bottle washing, paper pulp, trade products, timber seasoning, etc. It is extremely well illustrated with diagrammatic sketches.

A full range of the company's drying applications includes: artificial fibres; asbestos fibre and pulp products; barrels, bottles, jars and other containers; bricks, tiles and heavy clayware; cellulose films; chemical products; confectionery products; enamelled products; farinaceous foodstuffs; grains and cereals; leather, and imitation leather and products; paper in many varieties; pharmaceutical products; textiles and carpets; timber and wood products; tobacco and many other products.

Robert Kearsley and Co.—At the recent Commercial Motor Show, Robert Kearsley and Co., York Road, Ripon, made a special point of featuring passenger and commercial vehicle paints. In addition, they have comprehensive booklets dealing with both aspects of their business and outlining the various jobs they have done both for municipal and private organisations.



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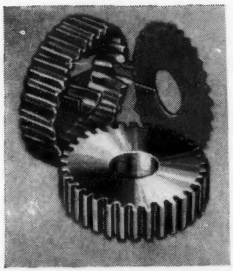

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APPROACH TO EMULSIFICATION

MUCH has been written and discussed in recent years about the practical application of ultrasonics. A new machine being made by Ultrasonics Ltd., of Central Chambers, Cheapside, Bradford, is of great interest to all engaged in the making of emulsions or suspensions. It is generally known that the process of emulsification has been fraught with great difficulties in the past and this machine, which is the outcome of several years' research in producing ultrasonic waves effectively by mechanical means, is claimed to provide the solution to these problems.

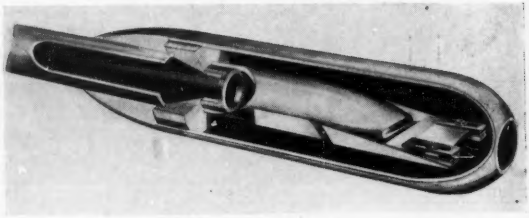
This machine, known as the "Rapisonic" (patents pending) is based on the principle of the Pohlmann Whistle. The vibrations are brought about by a jet of liquid impingeing on a blade which vibrates at its natural frequency. Both jet and blade are enclosed by a resonant bell, which concentrates the local ultrasonic effect.

Emulsification takes place when cavities are swept out by a blade which is oscillating at about 30 kc.—a frequency beyond the range of audition. On the collapse of these cavities instantaneous local pressures of the order of 30,000 lb. per sq. in. are built up. This is the basis of the machine's efficiency. Although there is still some doubt as to what actually causes the dispersion, it is certain that the cavitation plays the main part and that other effects are secondary.

It is well known that in order to intermingle one normally insoluble fluid with another, a high concentration of energy is needed. Generally the greater the amount of energy released on fluids the more intensive is the breaking down and consequently the smaller the particle size of the dispersion.

With ultrasonics the great advantage is that the concentration of energy is terrific. Mechanical methods of producing ultrasonics are concerned with sound

The "Rapisonic" homogeniser



The head of the "Rapisonic" homogeniser

strengths in the order of 1-2 watts/cm², and when one considers that this is several millions of times stronger than the sound from the average radio speaker, some idea of the energy concentration can be formed.

The limit of audition in air is a wave of approximately 2 cm. In liquids, the figure is approximately 10 cm. Anything above this range is classed as ultrasonic and the wavelengths are correspondingly shorter. It is the short wave feature of ultrasonics which enables them to be easily directed, whereas with sonic frequencies only a comparatively small degree of direction is possible.

So fine are the emulsions obtained with this machine that in most cases the amount of emulsificant can be reduced and in some left out altogether. This feature is particularly attractive where conventionally-made emulsions contain an agent undesirable in the finished product.

The "Rapisonic" has an output of 420 gall. per hour and has the additional advantage of being fully portable; it can be clamped on the side of existing mixing vessels. All parts in contact with liquids are of stainless steel and other parts are made in light-weight alloys wherever possible, to keep the power/weight ratio down to a minimum.

The frequency at which the blade vibrates can be easily adjusted and the machine as a whole has been designed for utmost convenience of use and maintenance. The internal parts of the ultrasonic head can be dismantled by hand, and cleaning is but a minute's work.

INSTANTANEOUS TIN-PLATE GAUGE

BY using X-rays to generate a small area of fluorescence in the base metal, Jones and Laughlin Steel Corporation of America, have recently designed and built a new instrument that gives an instantaneous measurement of the tin coating on fast moving tin-plate while it is being produced. This control method has been put to practical use in the production of commercial tin-plate for the food packing industry. The device measures tin coatings in millionths of an inch, does it in a fraction of a second, and gives a visual continuous record of the thickness.

It provides the operator with a constant check on line performance and an immediate adjustment can be made to produce a higher degree of coating-weight uniformity than has ever before been possible. He can, hour after hour, maintain a uniform product that meets the exacting requirements of the food processors.

This is the first continuous automatic check on the fast electrolytic method of applying tin to steel. With this instrument the quality of tin-plate can be improved and, at the same time, production can be accelerated. Furthermore, the device can serve as the primary element in a monitoring system to control the tin-plate line automatically.

With such an instrument, the tin-plate industry can take full advantage of the precise electrolytic deposition process and reduce the over-use of tin on the base metal with complete confidence that the coating will be uniform and just thick enough for the purpose intended. This saving alone will greatly increase tin-plate production with the same amount of tin.

Compare this to the old, time consuming method of checking coating thickness previously used, where they had to (1) stop the tin-line (2) cut out a sample (3) punch out several test coupons (4) run them through a laboratory electrolytic detinning process, and (5) titrate the solution to determine the tin content. It meant a 15-min. time lag or blind spot in tin-line operation.

Secret of the new device lies in the fact that X-rays of a certain wave length will cause fluorescence in the steel sheet, but not in the coating. With an X-ray tube and scintillation counter mounted in front of the puller roll, X-rays are shot at the tin-plate and the resulting fluorescence measured as the tin-plate speeds past. A screw-driven base permits positioning the instrument so it can scan the coating at any point along the strip width by merely pushing a control button.

The new gauge's principle of operation is applicable to other coatings, but at the moment emphasis is being placed on its ability to conserve and extend the available supplies of tin.

Society of Chemical Industry—Corrosion Group.—On the 8th December, Dr. U. R. Evans will present a lecture on "The Corrosion Resistance of Stainless Steel" at the Grand Hotel, Leopold Street, Sheffield. This occasion will be a joint meeting with the S.C.I. Yorkshire Section and the Sheffield Metallurgical Association.

Pretreatment Etch Primers of the Single Solution Type

PART II

by E. E. HALLS

IN the first part of this article the author gave details, together with a summary of conclusions, of comparative tests upon single solution etch primers from three different sources of supply (Nos. 1, 2 and 3) against a good two-solution etch primer (No. 4). The following tables show the results obtained: Two further tables will appear in INDUSTRIAL FINISHING, December, 1952.

TABLE 1.
FINISHES USING SELF-ETCH PRIMER ON ALUMINIUM—INITIAL ASSESSMENT

Sample No.	*Finish*	*Primer No.*	*Film Quality as Shown By:* *Scratch Test*	*Bend Test*	*Remarks*
1	Primer only, air dried for 1 day	1	Could be removed with thumb nail	Satisfactory	Rather soft
2		2	Perfect	Perfect	A tendency to softness
3		3	Could be removed with thumb nail	,,	Rather soft
4		4	Perfect	,,	Hard film
5	Primer only, stoved 20 min. at 250° F. and tested after 1 day.	1	,,	No flaking or cracking but could be removed with thumb nail along bend	Good
6		2	,,	Perfect	Very good
7		3	,,	No flaking or cracking but could be removed with thumb nail along bend	Good
8		4	,,	Perfect	Very good
9	Primer air dried 1 hr. and cellulose enamel air dried 1 day	1	,,	No flaking, fine cracking and could be easily scraped off bend with thumb nail	Rather poor
10		2	Tendency to chip in places	Fine cracks but adhesion good	Moderate
11		3	Perfect	Perfect	Very good
12		4	,,	Fine cracks, removable along bend with thumb nail only with difficulty	Fairly good
13	Primer air dried 2 hr. and cellulose enamel air dried 1 day	1	Bad chipping	No flaking, fine cracks, easily scraped from bend	Poor
14		2	Perfect	No flaking, fine cracks, scraped from bend with thumb nail only with difficulty	Good
15		3	,,	Perfect	Very good
16		4	,,	No flaking, fine cracks, adhesion perfect	Good
17	Primer stoved 20 min. at 250° F. cooled 1 hr. and cellulose enamel air dried 1 day	1	,,	No flaking, fine cracks, easily scraped off bend with thumb nail	Rather poor

Sample No.	Finish	Primer No.	Film Quality as Shown By: Scratch Test	Bend Test	Remarks
18		2	Primer perfect, top coat chips	Primer perfect, top coat cracks	Primer very good
19		3	Perfect	No flaking, fine cracks, adhesion perfect	Very good
20		4	,,	Perfect	Very good
21	Primer stoved 1 hr. at 250° F. cooled 1 hr., and cellulose enamel air dried 1 day	1	,,	No flaking, fine cracks, easily scraped off bend with thumb nail	Rather poor
22		2	,,	No flaking, top coat cracks, primer perfect.	Primer very good
23		3	,,	Perfect	Very good
24		4	,,	No flaking, fine cracks, adhesion perfect	,,
25	Primer air dried 1 hr.	1	,,	Perfect	,,
26	and stoved enamel,	2	,,	,,	,,
27	tested after 1 day	3	,,	,,	,,
28		4	,,	,,	,,
29	Primer air dried 2 hr.	1	,,	,,	,,
30	and stoved enamel,	2	,,	,,	,,
31	tested after 1 day	3	,,	,,	,,
32		4	,,	,,	,,
33	Primer stoved 20 min.	1	,,	,,	,,
34	at 250° F. cooled 1	2	,,	,,	,,
35	hr. and stoved ena-	3	,,	,,	,,
36	mel, tested after 1 day	4	,,	,,	,,
37	Primer stoved 1 hr.	1	,,	,,	,,
38	at 250° F. cooled 1	2	,,	,,	,,
39	hr. and stoved ena-	3	,,	,,	,,
40	mel, tested after 1 day	4	,,	,,	,,

TABLE 2.

FINISHES USING SELF-ETCH PRIMER ON BRASS—INITIAL ASSESSMENT

Sample No.	Finish	Primer No.	Film Quality as Shown By: Scratch Test	Bend Test	Remarks
1	Primer only air-dried for one day	1	Could be removed with thumb nail	Satisfactory	Rather soft
2		2	Perfect	Perfect	A tendency to softness
3		3	Could be removed with thumb nail	,,	Rather soft
4		4	Perfect	,,	Hard film
5	Primer air dried 1 hr. and cellulose enamel air dried 1 day	1	,,	No flaking or cracking but film along bend could be scraped off with thumb nail	Rather poor
6		2	Tendency to chip in places	Fine cracking but adhesion perfect	Moderate
7		3	Perfect	No flaking, fine cracking, adhesion perfect	Good
8		4	,,	Perfect	Very good
9	Primer stoved 20	1	,,	,,	,,
10	min. at 250° F. and	2	,,	,,	,,
11	tested after 1 day.	3	,,	,,	,,
12		4	,,	No flaking, fine cracking, but adhesion good.	Good

Sample No.	Finish	Primer No.	Film Quality as Shown By: Scratch Test	Bend Test	Remarks
13	Primer stoved 20 min. at 250° F. cooled 1 hr. and cellulose enamel air dried 1 day.	1	,,	No flaking, or cracking, film could be removed by thumb nail	Rather poor
14		2	,,	Perfect	Very good
15		3	,,	,,	,,
16		4	,,	No flaking, fine cracking, enamel only could be scraped off with thumb nail	Rather poor enamel, primer quite good
17	Primer stoved 20 min. at 250° F. cooled 1 hr. and stoved enamel, tested after 1 day.	1	,,	Perfect	Very good
18		2	,,	,,	,,
19		3	,,	,,	,,
20		4	,,	,,	,,

TABLE 3.

FINISHES ON ALUMINIUM—PERFORMANCE UNDER SALT SPRAY TEST

Sample No.	Finish	Primer No.	Test Period Days	Performance	Remarks
1	Primer only, air dried for 1 day	1	56	No visual deterioration, no blistering or peeling. Film soft and removed by thumb nail. Scratch and bend tests satisfactory, but film could be scraped off bend with thumb nail.	Quite good
2		2	56	No visual deterioration. Film resistant to finger nail scratching. Scratch and bend tests perfect.	Very good
3		3	56	No visual deterioration, no blistering or peeling. Film soft and easily removed by thumb nail. Scratch and bend tests satisfactory, but film could be scraped off bend with thumb nail.	Quite good
4		4	56	No visual deterioration, no blistering or peeling. Film hard. Bend and scratch tests satisfactory.	Very good
5	Primer only stoved 20 min. at 250° F.	1	56	Traces of white corrosion at edges, otherwise no visual deterioration. Resistant to thumb nail. Scratch and bend tests satisfactory, though finish could be scraped off bend with thumb nail.	Quite good
6		2	56	No visual deterioration. Scratch and bend tests perfect.	Very good
7		3	56	No visual deterioration, no blistering or flaking. Film resistant to thumb nail scratching. Scratch and bend tests satisfactory, but film could be scraped off bend with thumb nail.	Quite good
8		4	56	No visual deterioration. Scratch and bend tests perfect.	Very good
9	Primer air dried 1 hr. and cellulose enamel	1	56	No visual deterioration, no blistering or flaking. Resistant to finger nail scratching. Marked chipping on scratch test. Some cracking on bend test and film removed along bend by thumb nail.	Embrittled somewhat
10		2	56	Ditto	Ditto

Sample No.	Finish	Primer No.	Test Period Days	Performance	Remarks
11		3	56	No visual deterioration, no flaking or blistering. Scratch and bend test perfect.	Very good
12		4	56	A few tiny blisters near one edge. No flaking. Scratch and bend test perfect.	Very good
13	Primer air	1	56	Exactly as sample 9.	Embrittled
14	dried 2 hr.	2	56	Exactly as sample 10.	somewhat
15	and cellulose	3	56	Exactly as sample 11.	Very good
16	enamel	4	56	No visual deterioration. Scratch and bend tests perfect.	Very good
17	Primer stoved 20 min. and cellulose enamel	1	56	No visual deterioration, no blistering or flaking. Resistant to thumb nail scratch. Scratch test perfect. Bend test, strained, but no cracking or flaking, but enamel removed from bend with thumb nail.	Quite good
18		2	56	No visual deterioration, no blistering or flaking. Resistant to thumb nail scratching. On scratch test, enamel chips badly, but primer remains adherent and intact. On bend test, fine cracks, but adhesion very good.	Very good
19		3	56	No visual deterioration, no flaking or blistering. Resistant to thumb nail scratching. Scratch and bend tests perfect.	Very good
20		4	56	Ditto	Ditto
21	Primer	1	56	Exactly as sample No. 17.	Quite good
22	stoved 1 hr.	2	56	Exactly as sample No. 18.	Very good
23	and cellulose	3	56	Exactly as sample No. 19.	Very good
24	enamel	4	56	Exactly as sample No. 20.	Very good
25 & 29	Primer air dried for 1 hr. or for 2 hr. and stoved enamel	1	56	No visual deterioration, no blistering or flaking. Resistant to finger nail scratching. Scratch test perfect. On bend test a little splitting and flaking at edges of panel, film strained but no general cracking. Film along bend adherent to thumb nail.	Good
26 & 30		2	56	No visual deterioration, no blistering or peeling. Resistant to thumb nail scratching. Scratch test perfect. On bend test, fine cracks formed, but no flaking and film along bend resists thumb nail.	Very good
27 & 31		3	56	No visual deterioration, no flaking or blistering. Resistant to thumb nail scratch. Scratch and bend tests perfect.	Very good
28 & 32		4	56	Ditto	Ditto
33 & 37	Primer stoved 20 min. or for 1 hr. and stoved enamel.	1	56	No visual deterioration, no blistering or flaking. Resistant to thumb nail scratching. Scratch test perfect, but on bend test film flakes off (primer and enamel).	Rather poor
34 & 38		2	56	No visual deterioration, no flaking or blistering. Resistant to thumb nail scratching. Scratch test perfect. On bend test, fine cracks, but adhesion perfect.	Very good

Sample No.	Finish	Primer No.	Test Period Days	Performance	Remarks
35 & 39		3	56	No visual deterioration, no flaking or blistering. Resistant to thumb nail scratching. Scratch and bend tests perfect.	Very good
36 & 40		4	56	Ditto	Very good

TABLE 4.

FINISHES ON BRASS—PERFORMANCE UNDER SALT SPRAY TEST

Sample No.	Finish	Primer No.	Test Period Days	Performance	Remarks
1	Primer only air dried	1	7	Bluish-green corrosion along bend. blisters also along bend. No other visual deterioration.	Fairly good
			14	No apparent change.	
			28	Corrosion heavy at bend, some corrosion along one edge.	
			56	Little further visual change. Film resistant to thumb nail scratching. Scratch test perfect. Bend test satisfactory, but film could be scraped off bend with thumb nail.	
2		2	7	No visual deterioration.	Relatively very good
			14	Corrosion along bend.	
			28	Corrosion increased and extended down one edge.	
			56	Little further deterioration. Film resistant to finger nail scratching. Scratch and bend tests perfect.	
3		3	7	Light corrosion of bluish green products at bend.	Rather poor
			14	Patches of corrosion over general surfaces.	
			28	Increased corrosion, but no apparent flaking of film.	
			56	Increased corrosion. Film easily removed by thumb nail. Scratch test, film drags off the panel. Bend test, film peels at corrosion areas, otherwise satisfactory.	
4		4	7	Unaffected.	Very good
			14	Light corrosion along bend.	
			28	Little apparent change.	
			56	No further deterioration. Adherent to thumb nail scratch. Scratch and bend tests satisfactory.	
5	Primer air dried and cellulose enamel	1	7	Blisters and bluish-green corrosion along bend.	Rather poor
			14	Increased blistering along bend.	
			28	Blisters and corrosion heavy along bend. Blisters along edges and a few on surfaces. No flaking of film and very little change in colour and gloss.	
			56	Blistering increased, but film resistant to thumb nail scratching. Scratch test perfect and on bend test, film flakes only at edges but is easily removed from the bend by finger nail.	
6		2	28	First signs of deterioration, small blisters and corrosion along edges.	Good

Sample No.	Finish	Primer No.	Test Period Days	Performance	Remarks
			56	Slight increase in blistering but film resistant to finger nail scratching. Scratch test perfect, but on bend test fine cracks formed in film which flakes at edges and can be removed along bend with thumb nail.	
7		3	14	First deterioration shown as small blisters along bend.	Rather poor
			28	No flaking of film although wrinkling and slight corrosion at edges and inwards for a quarter of an inch.	
			56	Wrinkling increased. On scratch test, bad chipping. On bend test, fine cracks with flaking at edges, and film could be scraped from the bend.	
8		4	32	First signs of deterioration shown by small blisters and slight corrosion along bend.	Very good
			56	No further deterioration and film resistant to thumb nail scratching. Scratch and bend tests perfect.	
9	Primer only stoved for 20 min.	1	7	Bluish-green corrosion along bend.	Good
			14	Increase in corrosion.	
			28	Slight blistering near one edge, no flaking.	
			56	Little apparent change and film resistant to thumb nail scratching. Scratch test perfect, and bend test satisfactory although film could be removed from bend by thumb nail.	
10		2	14	Slight corrosion at edges.	Very good
			28	Increase in corrosion, no flaking.	
			56	Little further change and film resistant to thumb nail scratching. Scratch and bend tests perfect.	
11		3	14	Heavy corrosion along bend and edges.	Poor
			28	No flaking of film.	
			56	Corrosion extended to surface and film easily scraped off with thumb nail. Scratch test, film drags away from metal. Bend test, film flakes at corroded areas, and could be scraped off along bend.	
12		4	7	Blue-green corrosion light along bend.	Very good
			14	Corrosion increased slightly.	
			28	Little further apparent change.	
			56	Ditto, film adherent to thumb nail scratching. Scratch and bend tests perfect.	
13	Primer stoved and cellulose enamel	1	7	Blue-green corrosion and blisters along bend.	Fairly good
			14	Increased blistering.	
			28	Corrosion increased, blistering down edges, no flaking or loss of colour and gloss.	
			56	Blistering along edges increased but film resistant to thumb nail scratching. Scratch test perfect. On bend test, film cracks at edges but is perfectly adherent.	

Sample No.	*Finish*	*Primer No.*	*Test Period Days*	*Performance*	*Remarks*
14		2	28	Tiny blisters at edges.	Very good
			56	A little increase in blistering but film adherent to thumb nail scratching. Scratch test perfect. On bend test, fine cracks but film adherent.	
15		3	14	Tiny blisters forming along edge.	Very good
			28	Increase in blistering, but very little corrosion and no flaking.	
			56	A little increase in blistering but film resistant to thumb nail scratching. Scratch test perfect. On bend test, slight cracking at edges but adhesion perfect.	
16		4	7	Slight discoloration by corrosion at bend.	Very good
			14	Slight increase in corrosion.	
			28	A few only tiny blisters at edges.	
			56	Little further change, film resistant to thumb nail scratching. Scratch and bend tests perfect.	
17	Primer and stoved enamel	1	7	Blue-green corrosion and blisters along bend.	Fair
			14	Increased blistering.	
			28	Blisters also along edges and a few on surfaces. No flaking and little loss of colour and gloss.	
			56	Slight increase in blistering, but resistant to thumb nail scratching. Scratch and bend tests satisfactory except at blisters.	
18		2	28	Tiny blisters and slight corrosion at bend and edges. Few blisters on surfaces.	Moderate
			56	Increased blistering but film resistant to thumb nail scratching. Scratch test perfect. On bend test, film cracks and flakes in patches.	
19		3	7	Slight discoloration by blue-green corrosion at bend.	Very good
			14	Tiny blisters formed at bend and along one edge.	
			28	Edges corroding, few blisters at edges. Little loss of colour and gloss.	
			56	Little further change and film resistant to thumb nail scratching. Scratch and bend tests perfect.	
20		4	56	Very little sign of deterioration. Film resistant to thumb nail scratching. Scratch and bend tests perfect.	Very good

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Oil and Colour Chemists' Association—London Section.—The December meetings of the Section will be as follows: 12th December, at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1. Post Graduate Lecture by Dr. C. E. H. Bawn, F.R.S., "Autoxidative Reactions—their Chemistry, Mechanism and Catalysis by Metal Salts." 16th December, at the Royal Society of Tropical Medicine and Hygiene, Manson House, 26 Portland Place, W.1. "Radiochemistry in Paint Research," by D. F. Rushman, Ph.D., B.Sc., A.R.C.S. The 5th December is scheduled as "Ladies' Night" and will be held at the Criterion Restaurant, London W.1.

ROLLER HEATERS

HEATED rollers are used in many industrial processes, and various methods of heating the rollers are employed. A 30-kw. Metrovick electric roller heater incorporated in a machine at the Hollinwood factory of Ferranti Ltd. is an example of the latest technique in this direction. The machine is claimed to be the largest resin-bonded paper tube-making machine in Europe and is capable of winding a laminated cylinder of resin-impregnated paper 9 ft. in diameter and 12 ft. long (Fig. 1). Its successful operation depends to a large extent on the uniform heating of the pressure roller, which is 12 ft. 6 in. long and 2 ft. dia., maintaining a temperature of 170° to within plus or minus 3° C. along the length of the roll. In addition, thermostatic general control of temperature is required to within plus or minus 3° C.

In order to achieve such close limits of temperature and at the same time avoid an over lengthy heating-up time it was decided to split the heater into two main sections of 15 kw., each section being distributed over the length of the roller. One of these sections was split again into three entirely independent

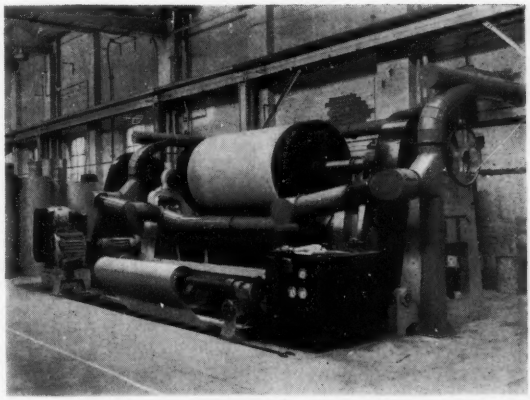


Fig. 1. Largest resin-bonded paper tube-making machine in Europe fitted with Metrovick 30-kw. electric roller heater. The pressure roller is shown below the paper-winding cylinder

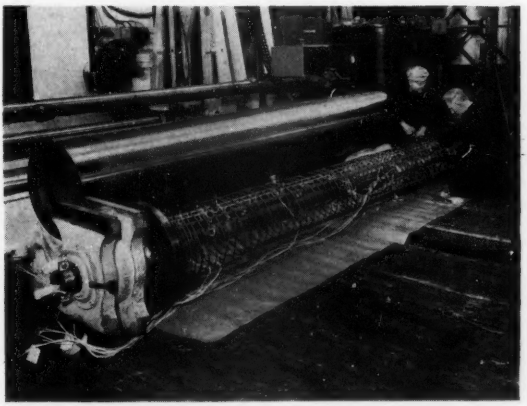


Fig. 2. 30-kw. Metrovick heater being wired before insertion into the pressure roller

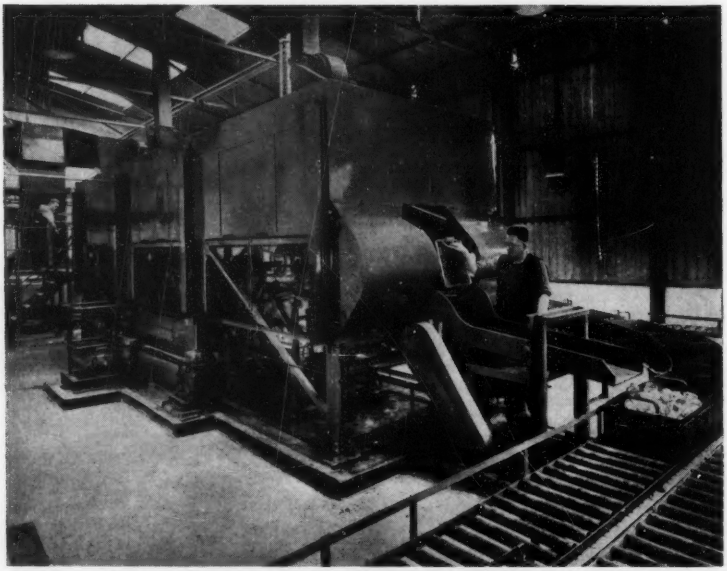
banks separately controllable and having loadings of 6 kw., 3 kw. and 6 kw. respectively.

The heater comprises tubular sheathed elements which consist of a spiral of high-grade heat-resisting wire tightly embedded by a special process in a mineral insulator, enclosed solidly in an outer sheath of $\frac{5}{16}$-in. tube of a non-scaling, non-corrodible alloy. The process ensures that the spiral is held immovably in the centre of the bore so that an even thickness of insulation separates it from the sheath. The elements, which are carried on a fixed spider (Fig. 2) are specially arranged to give a higher heat output at the roller ends to compensate for the greater heat loss in this region, thus ensuring uniform heating.

Temperature control is effected by means of Eher radiation thermocouples mounted on the heater spider, but arranged to measure the temperature of the internal roller face. Tests revealed a high degree of uniformity of temperature along the length of the roller, the maximum divergence being plus and minus $1\frac{1}{2}$° C. and there was no difficulty in maintaining the general temperature to the required limits.

Degreasing and Bright Dipping of Brass Pressings

THE following describes an installation at Singer and Co. Ltd., Frome, Somerset, where pressings are conveyed in work tins on a gravity roller conveyor into a tumbler which discharges them into a feed chute. The chute is manually operated to fill stainless steel perforated baskets attached to a continuous cam-operated conveyor forming an integral part of the plant. The conveyor moves forward with a series of pauses, each of



A general view of the Singer and Co. Ltd. plant at Frome, Somerset

10 sec., during which time the cam action lowers the baskets of pressings into the various tanks.

The baskets of pressings are dipped three times in a 90-gal. capacity tank with a concentration of approximately 1 lb. of potassium hydroxide per gal. of water: the total immersion time being 30 sec. at a temperature of 180° F. The pressings are then passed into a cold rinsing tank for 10 sec. and then into a tank of 25 per cent. sulphuric acid solution for another 10 sec. After this, the baskets of pressings are dipped in a 90-gal. capacity tank of approximately 77 per cent. sulphuric acid solution for 10 sec., and finally they are dipped twice in a hot rinse; the total immersion time here being 20 sec. at a temperature of 210° F.

The make-up in the potassium hydroxide tank is approximately ½ gal. of water an hour with potassium hydroxide added at intervals as necessary. The water, which is continuously running in the cold rinse, is carried forward by the material being treated to the other tanks, and the sulphuric acid replacement is approximately 20 gal. per day.

The plant was made by Electro-Chemical Engineering Co. Ltd., Weybridge, Surrey, and each tank is constructed of stainless steel with ½ in. insulation and aluminium outer case. Radiant Heating Ltd., Duoflam jets are employed, made up into a U-type burner having a maximum gas rate of 740 c. ft. per hr. (3·52 therms). The temperature of the installation is controlled by an indirect rod type thermostat and relay valve at 2·5 in. water gauge. A Jeavons compensating governor controls the pressure.

The gas consumption is 2·65 therms for a throughput of 4,734 lb., the time to reach working temperature being 30 min. The result is 5·6 B.Th.U. per lb. of pressings treated.

Reproduced from report No. 509/52 of the Industrial Gas Development Committee of the Gas Council (Information supplied by the South Western Gas Board).

THE THEORY AND PRACTICE OF VITREOUS ENAMELLING

J. H. Gray. Industrial Newspapers Ltd., London. Price: 10/6d.

THE author, Mr. J. H. Gray, A.I.Mech.E., is well known to most in the vitreous enamelling field, and it is pleasing that he has thought fit to carry on the work of his father, Mr. J. T. Gray, who died in 1949 and whose death "robbed the industry and the Institute of a staunch and popular champion."

In about 40 pages the author deals from the student point of view with a short history of the craft followed by notes on frits, milling practice, sheet iron quality, the design, characteristics, the preparation, groundcoat application, drying, fusing and inspection. In Part 2, reference is made to sheet iron cover coating, brushing and transferring, castings for wet process enamelling, the preparation of castings, the processing of castings and final inspection. Part 3 deals with colour matching, the various types of finish, the control of processing, a description of the enamelling furnaces and their control. Part 4 covers de-enamelling, the suspension of enamels, frit formulæ, enamelling faults and the care of furnaces. In the end there comes a glossary of terms, production hints and definition tables. The Appendix outlines some typical vitreous enamelling lay-outs. Altogether, this is a most useful book which gives an introduction to the student of what is meant by vitreous enamelling. It is particularly useful to the technical college and indeed to those firms who have either apprenticeship or trainee schemes. The book is packed with factual data and the subject is treated essentially on a practical basis.

All the proceeds from the sale of the book are being donated by the author to the funds of the Institute of Vitreous Enamellers, to be used in furthering its aims for the benefit of the enamelling industry.

Donald Leaver Ltd.—We have received from this Company, of 165 Railway Arches, Stamford Brook Station, London, W.6, a leaflet dealing with their hydro extractors, portable stirrers, filter presses and pumps, and ball mills. The Manchester office of the Company is 13/14 Parsonage Chambers, 29 Blackfriars Street, Manchester 3.

A Query.—A user of large quantities of paint hose and gun cleaners wishes to salvage the dirty solvent if they can find someone to re-claim it. Can anyone help?

Finishing Zinc and Aluminium Die Castings

THE recent Anglo-American productivity team report covering zinc and aluminium die-casting in a chapter dealing with finishing, states:

Finishing procedures seen in the plants were concerned almost entirely with pressure die castings in zinc alloy. Plating was the predominant method. At four plants finishing treatments were carried out on zinc alloy die castings made on the site, while one large plant specialised in finishing a variety of steel and zinc alloy components made elsewhere. In this plant the zinc alloy die castings came from a very limited number of producers.

Quality of Castings for Finishing

Die cast components intended to be finished were generally of a high standard of quality, to judge from the excellence of finish of the cast surface and the relative absence of flaws. Whether work was to be finished on the site or taken elsewhere for the purpose, a good deal of care was taken to achieve a product of adequate quality, and inspection procedures were devised to ensure that the necessary standard was maintained.

Radiographic examination of a number of specimen castings secured during the plant visits has shown that the good visual assessment of the quality of surface is, in the main, associated with a good standard of internal soundness.

It is logical to infer that the reputed absence of a serious problem over the plating of zinc alloy die castings in the U.S.A. is at least partly due to the quality of the castings to be plated.

Appearance of Plated Work

Rather less attention was devoted to the appearance of plated work. The acceptable standards of lustre and freedom from flaws (i.e., the uniformity of polish and incidence of minor damage to the polished surface of the unplated casting in transit) were lower than those usual in the U.K.

The reason for the relatively lower visual quality of the plated work is to be found in the widespread adoption of automatic polishing equipment and the aim of eliminating as much subsequent hand polishing as possible.

The bulk of the plated castings seen were motor-car accessories and automatic polishing was used to a very great extent in preparing them for plating. This is clearly an ideal method of coping with the extremely long production runs of castings for the American motor-car industry. It gives a large output per man-hour as compared with manual polishing, but a somewhat less lustrous surface results and there is some lack of uniformity on account of "misses." These are remedied by hand if necessary, but in the final result the plated casting is, in the opinion of the Team, less attractive on close inspection than one prepared by manual polishing.

This point is conceded by the Americans, who contend, however, that the logical way of assessing the appearance of a plated component is by the impression it gives when in service. Some leniency is, therefore, exercised in the inspection of the lustre on plated castings. When durability is considered, however, no such leniency is permitted so far as casting flaws are concerned or as regards defects inherent in the plated coatings.

Preparation for Plating

(*a*) *Emery Bobbing*

The consistently good quality of the castings being produced reduces the need for emery bobbing to a minimum and this was restricted mainly to the parting line.

Emery of 180-mesh was used almost invariably. This was usually mounted on cloth wheels but occasionally on linisher bands on the back-stand type of equipment, particularly for bobbing internal surfaces. The well-known horn ring casting is an example of one treated in this way.

One plant had devised an interesting piece of equipment for bobbing the parting lines (and incidentally, but not intentionally, the sides) of car door handles. The machine comprised a wheel about 2 ft. 6 in. in dia. with radial posts on which door handles were loaded by hand, one per post. After 90° of travel, the handles were carried down between a pair of linisher belts supported by stitched cloth mops. At the bottom of the revolution the emeried work fell away into a container. This machine, devised especially for a particular job, dealt with 1,000 car door handles an hour.

(b) Polishing

Manual polishing was practised on a fair scale but automatic polishing was commonly adopted for those motor-car components which lent themselves to the method. Motor-car door handles were the most common example, though machines were also available for polishing lengthy die-cast grille fittings.

Hand polishing proceeded rapidly. Central belt conveyors were often used to transport the polished work to an inspector at the unloading point.

Manual work was expedited by polishing simultaneously several castings on suitable wooden-backed jigs. One polisher was assisted in loading and unloading the jigs by a female helper. As many as ten small components could be polished simultaneously over their significant faces, and simple devices were incorporated to enable the jigs to be unloaded in one operation.

A variety of automatic polishing machines for car door handles included in-line assemblies of mops, at the mid-point of which the supporting post was tilted to expose the unpolished face. Equipment of this type, loaded at one end and unloaded at the other, would polish 1,500 to 1,800 handles an hour, depending on their size. Subsequently the small area at the spigot end of the handle, not reached by the mops, was polished manually.

A "gyro-polisher" was used for polishing small car door handles at a plant concerned exclusively with motor-car components. There were four 30-35-second stages in the complete operation. At the first stage, some two dozen handles were loaded on a large head. The head was raised, turned through 90° and lowered into a rotating barrel containing a comparatively dry mixture of liquid tripoli compound and corn meal, and thence through another 90° to a second and similar barrel, and finally transferred to the off-load point. With four polishing heads in operation the machine was estimated to have an output of between 2,500 and 3,000 handles an hour.

Automatic machines with rotating tables were also employed. The work was loaded and unloaded at one point and passed intermediately eight mops, four dealing with each face. The output of such a machine was commonly rated at 1,000 polished pieces an hour, but 1,500 an hour was claimed in one plant.

One firm was making a comparison between solid tripoli polishing compound and liquid tripoli polishing composition when used in conjunction with polishing equipment of the rotating table type. Mop lives were stated to be eight hours when using solid compound and sixteen hours when using the liquid medium. The use of the latter was estimated to afford an overall economy of 30 dollars a shift.

Discarded mops, from both manual and automatic machines, were invariably returned to the suppliers to be cut down to smaller size. Solid polishing compound was also reclaimed by re-melting small pieces and casting in sticks of standard size.

An investigation was in hand at one plant to seek a suitable facing material for bedding the work during automatic polishing. It had been found that carbide-faced steel gave a life of five years and was satisfactory for the first half of the polishing cycle. To avoid scratching during the second half-cycle, however, fibre had to be used to carry the face already polished. The life of a fibre facing was six months.

(c) Cleaning

There were distinct contrasts between American and British practice in cleaning polished die castings. One major difference in the preliminary stage was the almost complete replacement of solvent cleaning by a soak in a proprietary alkaline emulsion cleaner with a surface layer of kerosene.

It was customary to pass racked castings through the cleaning solution (e.g., at a temperature of 165° F. for 3½-4 min.), and then through sprays of similar, though more dilute, cleaner. The kerosene in the cleaner had the effect of preventing complete drying out during the transfer of work from one stage to the next. The soak cleaner, in which much of the general "dirt" was removed, was regarded as inexpensive and was often discarded daily.

Work coming from the spray cleaner would be transferred to an automatic plating machine for the sequence of auxiliary cleaning followed by copper, nickel and sometimes chromium plating. The cleaning cycle was continued with an electrolytic cleaner—a proprietary mild alkaline solution at 160° F. to 180° F.—invariably with the work as anode. The electrolytic clean was in some cases preceded by a soak clean as the first stage in the automatic plating cycle. A hot alkaline cleaner or a soapy liquid was used for this, primarily to remove residual traces of kerosene.

Sulphuric acid was favoured for the dip prior to copper plating, its concentration ranging below 0·5 per cent. to as much as 5 per cent. The latter concentration resulted in visibly darkened work and was exceptional, it being the usual aim to minimise attack in the pre-dip.

Plating

The electrolytic cleaning and acid dip stages, commonly included in the automatic plating cycle, were followed by copper and nickel plating and, either directly or after inspection and transfer to a second machine, by chromium plating.

The copper strike deposit was almost universal on zinc alloy die castings and was plated from a Rochelle salt cyanide solution.

The desired thickness of copper was then usually built up in a Du Pont high-speed copper bath.

In one plant the Westinghouse "P.R." (periodic reverse) copper plating technique had been adopted. The cyanide copper solution containing a proprietary brightener was operated at 180° F., and at a current density, dependent on conditions and requirements, of between 40 and 80 amp./sq. ft. with 15 sec. of de-plating per minute. Cathode bar agitation was said to be necessary and considerable importance attached to filtration.

Anodes for copper plating were usually bagged with canvas or cotton. The bags were kept below solution level to minimise the rate of deterioration of material. There was a marked tendency to support anode copper in steel containers, spring cages being favoured for balls and expanded metal cages for pieces of thick plate. An interesting idea in one plant was the use of permanently fixed inclined chutes for feeding ball anodes into those cages which were not easily accessible from the sides of the automatic plating plant.

Nickel was invariably deposited from proprietary bright solutions carrying organic addition agents. The nickel deposit was activated before chromium plating by various methods, including dipping in dilute hydrofluoric acid, or in an alkaline cyanide solution followed by 5-10 per cent. sulphuric acid, with intermediate rinses.

One plant preferred a chromium plating solution with a sulphate ratio of 1:85 and containing some hydrofluoric acid. The latter was controlled by Hull cell tests, the amount present being assessed by the ability of the solution to cover nickel plated panels and by the mode and quantity of gas evolution.

Substitute Plated Finishes

Considerable interest was shown in the development of substitute finishes to reduce nickel consumption.

Ordinarily for outdoor service, die cast zinc alloy car fittings had been plated with a total thickness of up to 0·0015 in. of copper plus nickel. Work for indoor service had been plated with a combined copper and nickel thickness of 0·00075 in.

Such commendable standards of thickness had of necessity been modified by reducing the thickness of nickel or even by eliminating that metal altogether. At the same time, the thickness of copper had been increased and the final flash of chromium was followed by one and occasionally two coats of a colourless stoving enamel, of which the thickness was sometimes specified.

The trend in substitute finishes can be gauged from the following examples:

(*a*) *Inside service.* Deposit of 0·0003 in. copper, nickel flash, chromium (and occasionally, enamel) to replace 0·0003 in. copper, 0·00045 in. nickel, chromium.
Outdoor service. 0·0005 in. copper, 0·00005 in. nickel, chromium and then stoving enamel (0·0005 in.-0·001 in.) to replace 0·0005 in. copper, 0·001 in. nickel.

(*b*) Deposit of 0·0007 in. copper, chromium and two coats of clear stoving enamel.

(*c*) Deposit of 0·0003 in. copper, chromium and clear enamel.

Of these three schemes only the first, for both indoor and outdoor service, was being adopted on a production basis. The last scheme has been used for plating experimentally. One interesting practice was the electro-polishing ot the copper deposit for 45 sec. in 75 per cent. phosphoric acid at 6 volts at room temperature. A copper coating of 0·00035 in. deposited from a proprietary bright bath was reduced by 0·00005 in. in this way, but appreciably brightened thereby. The copper deposit on certain castings, which had been satin-finished with a wire wheel, was electro-polished in the same way.

Chemical and Organic Finishing

Plating was the main finishing process adopted in the plants visited. Some organic finishing was seen but it was usually as an adjunct to a plated finish and had been introduced to economise on nickel consumption. Chemical finishes were represented by the occasional use of Cronak treatment.

In one interesting set-up, a machining line for dealing with one die cast zinc alloy component terminated in a small plant for Cronak treatment. The parts concerned were handled batchwise on steel mesh trays and were passed through cleaner, Cronak solution and rinses. They were components of simple shape and were dried by passing through a tunnel oven at a temperature below 100° C.

Apart from this, Cronak treatment was used as a pre-treatment for enamelling.

In this instance, the components were enamel-coated by dipping and any deficiencies in the coating were made good by local touching-up with the spray gun.

The main use of organic finishes was for clear synthetic enamel coatings applied over chromium with the object of compensating for the reduced durability of composite coatings brought about by the elimination or reduction of the amount of nickel. The use of copper coatings of increased thickness, followed by chromium plating and one or two coats of clear stoving enamel, was being advocated and adopted in place of the standard copper-nickel-chromium finish. This substitute finishing scheme was accepted with some reserve as an unavoidable expedient. No forthright opinions of its durability in service were expressed. The clear enamels were selected on the results of accelerated tests and a minimum coating thickness was often specified.

A glyptal-urea enamel was used in one case. This was perfectly compatible with a coloured enamel applied just previously through a mask to recessed lettering on a plated casting. Both coloured and colourless enamels were stoved together for 30 min. at 275° F. Elsewhere, 235°-240° F. was regarded as the safe maximum temperature for stoving clear enamel coatings on plated castings.

An interesting pressure-release spray was used for enamelling the recessed parts of one casting. The operator had only to press the castings down (two at a time) on the mask for them to be enamelled in the appropriate places.

Handling

A particular feature of the finishing operations seen in progress was the extent to which mechanical handling was adopted.

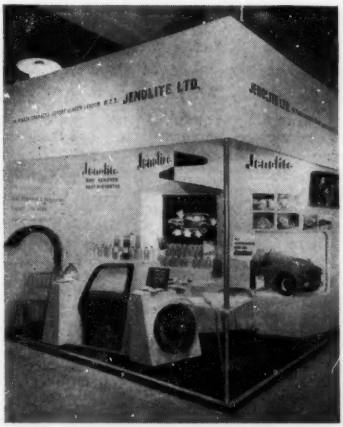
Work from the polishing machines was usually transferred to the plating section in trays or tote boxes, polished castings being packed in single layers interleaved with stiff cardboard or compo board. From these the work was loaded on racks suspended from overhead conveyors and was passed through the degreasing plant prior to automatic plating.

Once the work had been loaded on the first conveyor, manual handling took place only at strategic points where inspection or the transference of racks from one conveyor to another was undertaken.

Enamelling was less conspicuously adapted to mechanical handling. However, work passing through stoving ovens invariably did so on a belt or overhead conveyor.

THE MOTOR SHOW

NEW designs for speed and comfort together with the news that for the first time since the war manufacturers were able to offer comparatively early delivery of many of the cars at the 1952 Earls Court Show, seemed to push the vital question of finish into the background.



The Jenolite Ltd. stand

Nevertheless all sections of the industry were represented in the finished products which have received so much praise, and individually, in the Accessory and Component Section, visitors to the show were introduced to a fair cross-section:

General and Industrial Paints Ltd., 28 Wadsworth Road, Perivale, Greenford, Middlesex: Glasso cellulose, cellulose matalescent finishes, half-hour synthetic and stoving synthetic enamels, and Glasso wax and liquid polishes.

Imperial Chemical Industries Ltd., Paints Division, Wexham Road, Slough, Bucks: Belco Metallichrome and nitrocellulose lacquers, and Dulux stoving car finishes.

Jenolite Ltd., 54 and 57 Piazza Chambers, Covent Garden, London, W.C.1: Jenolite rust remover and preventer, paint stripper, aluminium keying solution and wiping degreaser.

Pinchin, Johnson and Co., 4 Carlton Gardens, London, S.W.1.: Primers,

The stand of Pinchin, Johnson and Co.

primer surfacers, undercoatings and top coats for bodies, wings, wheels, chassis, etc., together with stoving and cellulose air-drying types.

The Pyrene Co. Ltd., 9 Grosvenor Gardens, London, S.W.1.: All types of fire extinguishers, foam-making branch pipes and mechanical foam generators and Pyrene bumpers.

The Zinc Alloy Rust-proofing Co. Ltd., Shakespeare Street, Horseley Field, Wolverhampton: Examples of the Sherardizing process, as carried out by makers of various components.

The finishing industry was also represented in the Transport Service Equipment Section:

Air Industrial Developments Ltd., 28 South Molton Street, London, W.1.: Portable and stationary compressors, spray guns, pressure containers, air transformers, pressure reducers, dusting guns, oil guns, corrosion inhibitor guns, etc., hot lacquer plant, the "Kigass" screen wash equipment and the "Kigass" engine priming equipment.

B.E.N. Patents Ltd., High Wycombe, Bucks: Portable and stationary compressors, portable spray painting units, spray guns, spray painting accessories, pneumatic tools and the Pulsator pre-set air meter.

R. Cruickshank Ltd., Camden Street, Birmingham 1; Burnishing Barrell (36 in. by 22 in.), filter press, I.B. centrifuge, and a complete P.R. copper plating unit.

B. O. Morris Ltd., Morrisflex Works, Briton Road, Coventry: Morrisflex flexible shafts and flexible shaft machines, polishing machines and accessories, rotary files, cutters and rasps, industrial wire and fibre brushes.

TWO NEW PRODUCTS

ARTHUR HOLDEN AND SONS LTD., Bordesley Green Road, Birmingham 9, announce two new products, namely Holdens Superfast air drying enamel for industrial users for which is claimed high-speed one coat coverage without a primer or undercoating, and yet giving requisite distribution qualities. Drying time—by air, 40 min.; convection stoving, 15 min.; infra-red, 3-4 min. It is claimed to have high resistance to alkalines, soapsuds, lubricating oils, soluble cutting oils, solvent, water and steam.

The other is Holdens Polymer emulsion paint for factory use. Quick application and quick drying are claimed. Two coats will dry in three hours. It can be applied by brush or spray and contains an anti-mould growth agent. It is claimed to be non-toxic, easily washable and applicable to a variety of surfaces including new plaster, cement, bricks, asbestos board, wood and steel. Properties also considered in the formulation include anti-condensation, freedom from odour and good flow and lapping properties, with no laying-off.

Ultrasonics in the Foundry.—Mullard Electronic Products Ltd., Century House, Shaftesbury Avenue, London, W.C.2., announce the introduction of Mullard ultrasonic soldering equipment which is claimed to provide an effective and efficient method for soldering aluminium and other light metals without flux.

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THE FIGHT AGAINST RUST

Twenty-five pages, nineteen illustrations, price 2s. 6d., post free, from the British Iron and Steel Research Association, 11 Park Lane, London, W.1.

THIS booklet describes the work of the Corrosion Committee of the British Iron and Steel Research Association. It is presented under the headings "Case Histories," "Applied Research," "Fundamental Research," and "Summary and Practical Conclusions." In the case of the first two subjects it deals with corrosion by air, water and soil giving seven case histories. It is fol'owed by systematic exposure tests and their conclusions, dealing with work on protective coatings and testing methods. Then follow summaries of work being conducted at Cambridge University and the Chemical Research Laboratory.

On the question of protective coatings the following extract will be of interest to our readers:

Two main types of protective coating are available for iron and steel: (i) paints and (ii) metallic coatings.

Protection by Painting

Some distinction is necessary according to whether the painting scheme is to protect steel from corrosion by the atmosphere or by water. Considerable progress has been made in both fie'ds. Earlier researches and service trials have demonstrated the importance of three things:

(1) Correct surface preparation of the steel for painting, e.g., millscale should be completely removed by pickling or grit-blasting and, for atmospheric work, any rust should be removed as well.
(2) Choice of the correct type of paint, particularly of the priming coat.
(3) Carefully controlled painting under good atmospheric conditions.

Present researches are being conducted with the collaboration of the paint industry and have special reference to the formulation of paints for the protection either of steel structures exposed to the atmosphere or of ships' bottoms. As a result a priming paint for atmospheric work, consisting of a mixture of red lead, white lead and asbestine in a linseed oil medium is under consideration for inclusion in a British Standard. An anti-corrosive paint resulting from the Corrosion Committee's researches was adopted several years ago by the Admiralty as the standard for the painting of new construction. These and other paints showing even better performance are being used with satisfaction by some leading shipping companies, including the Cunard White Star and Union Castle lines.

Metallic Coatings

Protective coatings of non-ferrous metals are being used to an increasing extent for preventing the rusting of steel. The Association is, therefore, conducting exposure tests to ascertain the relative value of the various types of coating under different conditions. Zinc is generally the most useful metal, but it is becoming scarce and expensive. It is fortunate, therefore, that research and

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INDUSTRIAL TECHNOLOGIST, age 33, University trained and experienced in technical sales in the paint and varnish industry and in the paint application industry, particularly infra-red stoving, seeks position where services will be useful.—Box No. 63, INDUSTRIAL FINISHING, 157 Hagden Lane, Watford, Herts.

experience have shown that for many purposes aluminium coatings are equivalent to zinc coatings. At the moment spraying is the only practicable way of applying aluminium to large and heavy steel articles, whereas zinc can be applied by a variety of processes. The normal industrial methods of applying the zinc do not make much difference to the protective value of the coating. To protect steel adequately for five years in an industrial atmosphere, such as that at Sheffield, a coating weighing about 1¾ oz. per sq. ft. of surface, or 3 mils. thick, is required. A sprayed aluminium coating about 4 mils. thick (0·8 oz. per sq. ft.) would be equally effective. The lives of these coatings in rural or marine atmospheres would be much longer. For example, hot-galvanised specimens carrying 2 oz. of zinc per sq. ft. of surface were exposed at Llanwrtyd Wells in 1931 and are still virtually unrusted.

In industrial atmospheres lead coatings or coatings of lead-tin alloy ("terne") give good protection, because a film of lead sulphate forms on them. They are of less value in country or marine districts where such a film does not form.

It is essential that the thickness of the metal coating applied be adequate for the purpose in hand; it would be injudicious to use thinner coatings than those indicated in industrial atmospheres. The same consideration applies to protection by means of paint. It is unwise to put a steel structure into service in any but a mildly corrosive atmosphere unless it carries a thickness of at least 5 mils. of paint. This corresponds to three good coats at least.

It is therefore desirable when possible to check the thickness of protective schemes at various points of the structure. This can generally be done by means of one of a number of non-destructive thickness testers now on the market.

ELECTRONIC TEMPERATURE MEASUREMENT AND CONTROL

NOW that the process units are rapidly taking shape at The Vacuum Oil Company's Refinery at Coryton, arrangements for the installation of all necessary instruments are well in hand. Where temperature measurement and control are concerned, the principal contractors — the Lummus Company Ltd.—have placed all orders for such instruments with Honeywell-Brown Ltd.

A total of eighty-five Brown ElectroniK instruments have been ordered, divided into three main categories: forty-five Brown Electronik circular chart potentiometer Air-O-Line recorders, twelve Brown ElectroniK multi-point precision indicators and twenty-eight Brown ElectroniK strip chart potentiometer recorders. These will be installed on the ten main process units —the two-stage crude distillation unit (which is now almost complete), the thermal reform unit, Thermofor catalytic cracking unit, motor spirit treating unit and motor spirit blending unit (these latter four dealing with diesel oil and finished motor spirit) and the propane de-asphalting unit, furfural treating unit, methyl ethyl ketone de-waxing unit and continuous clay percolation unit (these Lubeoil units dealing with finished lubricating oils, finished waxes and fuel oil).

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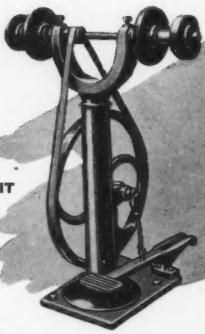

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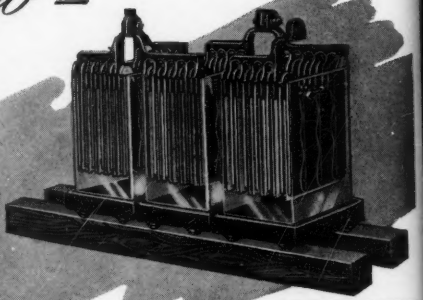

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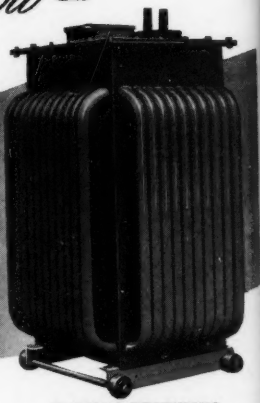

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